Approved resolutions to comments received during the first public review of BSR E1.43

Referenced document:
BSR E1.43-201X, Entertainment Technology—Live Performer Flying Systems (document number Rig/2013-2039)

ANSI public review period: 18 April through 2 June 2014
(Earlier responses will be accepted. Later responses may not be considered as part of this review.)

Question: Do you recommend that the standards committee accept BSR E1.43-201X (document number Rig/2013-2039), as an American National Standard, that its requirements are not too lax, too onerous, or too vague, nor that it would unreasonably negatively impact materially affected parties in the entertainment industry? Please indicate "Yes" (accept it), "Yes with comments," or "No with reasons" (don't accept it).

Responses:

Name	Representing	Yes	Yes with comments	No with reasons
John Van Arsdale	Univ. of Wisconsin-Madison (UWM)		X	
Jim Becker	Disney Cruise Line (DCL)		X	
Vince Davey	Vince Davey Technical Direction (VDTD)			X
Robert Dean	ZFX Inc. (ZFX)			X
Jonathan Deull	JSD Projects (JSD)		X	
James Heath	James Heath (JH)			X
Jeremy Hodgson	Cirque du Soleil (CDS)			X
Rocky Paulson	Rocky Paulson (RP)			X
Bethany Reinfeld	Bethany Reinfeld (BR)		X	
Delbert Hall	D2 Flying Effects, LLC (DFE)			X
Steven Santos	Simply Circus, Inc. (SCI)			X
Paul Sapsis	Sapsis Rigging Inc. (SRI)		X	
Dane Styczynski	DS Design Tech (DSDT)			X
Jim Shumway	Tait Towers (TT)		X	
Barry Brazell	Cirque du Soleil (CDS-2)			

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(Sorted by commenter)

#	Commenter	Clause	Comment	
1.	UWM	2.5	2.5 "Catenary-curved Trolley Track" is used in the definition of Cable Track Tension Line, but is itself not defined nor is it safe to assume that readers will know what this is. Suggestion: A clearer definition for Cable Track Tension Line, or adding a definition for Catenary-curved Trolley Track	Accept in principle. Change to: "**tensioned cable track:** Flexible medium statically suspended and tensioned between two points to form a catenary-curved track."
2.	UWM	2.11	2.11 D:d ration only appears to be referenced in 4.2.6.7 and is referred to as D/d ration. Suggestion: In Stage Rigging Handbook, Glerum refers to it as D/d ratio. Based on that , I recommend we keep what is already in the body of the text and change the term in 2. Definitions	Accept change. Change "D:d" to "D/d."
3.	UWM	2.14	2.14 FAT is defined as "Factory Acceptance Test". I suggest a more thorough definition of FAT is required. This would keep a consistency that is matched in the definition for SAT. Suggestion: 2.14 FAT: Factory Acceptance Test: a period of offsite testing during which the System Supplier demonstrates that the performer flying system meets the safety specifications.	Accept in principle. Change to "2.15 Factory Acceptance Test (FAT). A period of offsite testing prior to installation during which the System Supplier demonstrates that the performer flying system meets the performance and safety specifications to the extent possible during offsite testing. FAT testing requirements and performance criteria shall be agreed upon between the System Supplier and the User prior to FAT."
4.	UWM	4.8	4.8 Lifting medium switches wording mid-document to Lifting Media throughout 4.8 and A4.8.4.2. Suggestion: Keep wording consistent throughout document by changing all to Lifting Medium.	Accept in principle. Medium is singular, whereas media is plural. Change "media" to "medium" where applicable.
5.	UWM	2.18-2.19	2.18-2.19 limit definitions exist for limit, normal and limit, ultimate but not for limit, soft. Software ("soft") Limits are referenced in 4.10.2.2.11. 1-2 & A4.10.2.2.9. I suggest we add a definition for limit, software. Suggestion: Add 2.19 limit, software (soft): The software (soft) limit is the programmable control command that prevents further movement in the direction of travel. (And then adjust definition numbering accordingly.)	Accept in principle. **"**2.21 limit, software (soft): The software (soft) limit is a programmed reference position that prevents further movement in the direction of travel."
6.	UWM	4.2.1.2	4.2.1.2 ANSI E1.4-2009 "Entertainment Technology – Manual Counterweight Rigging System" has been superseded by ANSI E1.4-2014 "Entertainment Technology – Manual Counterweight Rigging System"	Accept change.
7.	UWM	4.2.6.3	4.2.6.3 "Flying System Designer shall promote redundancy in design to	Accept in principle. Change to: "Flying

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			mitigate single point failure points and cascading failures." The phrasing is awkward because of an appearance of redundancy in "point failure points". Additionally some reassurance regarding single point system scenarios would be helpful. Suggestion: Flying System Designer shall promote redundancy in design to mitigate single point failure and cascading failures. In single point system, Flying System Designer shall double the design factor to mitigate single point failure.	System Designer shall promote redundancy in design to mitigate single point failure and cascading failure. In situations where single points or cascading failure points of support are unavoidable, the Flying System Designer shall use a suitably conservative design factor to mitigate risks based on RA/RR." Add Annex note: "A4.2.6.3: Elements with single point failure conditions are common in performer flying, such as winch lines and carabineers. Suitable safety factors are used to mitigate these single point failure risks."
8.	UWM	4.3.3.1	4.3.3.1 Cable Track Tension Lines. The location for this within the document is unusual. Occurring at the beginning of 4.3.3 seems to imply a larger chronological significance then it needs. Assuming it's included here because it is specifically addressing the 4.3.3 Loading conditions, maybe it should be moved to the end of the section. Suggestion: Move 4.3.3.2 Dynamic outline first and then address Cable Track Tension Lines and 4.3.3.3 Environmental.	Accept change.
9.	UWM	4.3.3.2.3	4.3.3.2.3 Figures 1-5 have shadow lines in the background of the chart. The lines don't provide clarity to the chart and appear to be uneven in spacing. Suggestion: Some editing on the graph might be necessary to keep the chart clear.	Reject: "Shadow" lines are additional duration lines in half tone to assist in identifying graphical slope intercepts.
10.	UWM	5.8.4.2	5.8.4.2 Destructive: AHJ is not defined in either 2. Definitions or 3. Responsibilities. Suggestion: Unless it seems necessary to include in 3. Responsibilities, recommend changing the sentence to read "All destructive testing documents shall be kept on file and made available to local Authority Having Jurisdiction (AHJ) if requested."	Accept in principle. Add the following definition: "2.2 Authority Having Jurisdiction (AHJ): The organization, office, or individual responsible for approving equipment, an installation, or a procedure." Add Annex note: "A2.2: An AHJ is typically the governmental agency or sub-agency which regulates the work, such as a building department, fire marshal,

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				department of labor, health department, OSHA, etc. In most cases, the AHJ is defined by the municipality in which the performer flying installation is located."
11.	DCL	4.2.6.5	*4.2.6.5 End stops for traveler track* Has there been any discussion on end stops for mechanically compensated systems where the slave bogie is on the same track as the master bogie? Can an end stop be installed to stop the slave bogie if the drag lines are rated for the resulting dynamic load? How should such loads be calculated?	Reject. This subject is now covered in Section 4.2.7. This document does not address specific flying system designs. The commenter's questions are best addressed via a rigorous hazard analysis, failure mode analysis, and risk reduction process applied to the specific compensation technique.
12.	DCL	4.10.2.2.10	*4.10.2.2.10 When multiple actuators are used to perform an individual flying effect, the actuators shall be linked by the control system so that any fault shall stop motion of all actuators for that individual effect.* Is this referring to multiple actuators driving a single plan of movement or is this multi plan system such as a 3D flight? I would like to have it clarified either way.	Accept in principle. Change to: "When <u>two or more</u> actuators are used to perform an individual flying effect, <u>and the fault of one of the actuators puts the flying performer at risk of harm,</u> the actuators shall be linked by the control system so that any fault shall stop motion of all actuators for that individual effect."
13.	VDTD	4.3.3.2.3	Page 11: Graph is difficult to read in digital format consider reformatting to not run vertically. Consider making the first column in the graph Eyeballs in, Eyeballs out, Eyeballs left, Eyballs right, Eyeballs up, and Eyeballs down. Otherwise the term can get lost.	Accept change. This subject is now covered in Section 4.3.3.1.3. Table is changed as proposed.
14.	VDTD	4.3.3.2.3	Keep consistent terminology between graphs on page 11 and the ones on pages 12-14 either Eyeballs in or Eyes in.	Accept change. This subject is now covered in Section 4.3.3.1.3. Change "eyes" to "eyeballs."
15.	VDTD	4.3.3.2.7	4.3.3.2.7 Typo: Should read the F was left out of Flying System Designer	Accept grammatical change.
16.	VDTD	4.5.1.3	4.5.1.3 The application of costumes, paint, or any additional material to the harness shall not compromise the strength of the material, interfere with its operation or impede the inspection of the stitching and connection hardware. Proposed Change: The application of costumes, paint, or any additional material to the harness shall not compromise the strength of the material, interfere with its operation, or impede the inspection of the stitching and	Accept in principle. "The application of costumes, paint, or any additional material to the harness shall not compromise the strength of the material, interfere with its operation, or impede the inspection of the stitching and connection hardware. <u>Any application or addition shall be approved by</u>

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			connection hardware. **Any application or addition shall be approved by manufacture, Fly Safety Supervisor, or Flying Supervisor.**	manufacturer or Flying Safety Supervisor."
17.	VDTD	Definitions	Additional Definitions: Duty Cycle: the percentage of one period in which a signal is active. A period is the time it takes for a signal to complete an on-and-off cycle. Fatigue Cycle: The cycle in a repetitive use system at which deformation or failure is expected to appear in the lifting medium	Accept in principle. Add definition: "2.28 Operating cycles: One complete series of motions consisting of a move in one direction followed by a move in the opposite direction. Programmed cues may consist of multiple operating cycles in one motion profile." The following will be added to section 4.2.6: "4.2.6.4: The Flying System Designer shall determine the anticipated operating cycles for the flying system." The following changes will be made: 4.8.1.2 ~~"The material chosen for the lifting medium shall be selected to meet the service life requirement based on the expected~~ number of operating use cycles ~~during its life~~ ~~duty cycle, the required availability of the system, and maintenance schedule of the performer flying system."~~ "The lifting media selection shall consider the anticipated number of operating cycles and inspection and maintenance frequency." 4.8.9.1 "Cycles: Use the number of bend and loading cycles to determine the expected service life of lifting medium elements. Service life is determined by multiplying the number of bending/loading cycles on the lifting medium during each operation by the anticipated total number of operations, which include testing,

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				rehearsal, maintenance, and performance. ~~The expected duty cycle of the equipment shall be used to determine the number of bend and loading cycles in order to determine the number of fatigue cycles on the lifting medium elements~~." 4.8.9.2 "Diameter and quantity of sheaves and rollers: ~~In the case of flexible lifting medium, the diameter, quantity, and relative position of the sheaves and rollers in the performer flying system shall be used to determine the number of fatigue cycles on the medium during each operation.~~ In the case of flexible lifting medium, the quantity and relative position of the sheaves and rollers in the performer flying system shall be used to determine the number of bending fatigue cycles on the lifting medium during each operation. The number of bending fatigue cycles, the number of changes bend direction, and the D/d ratios shall be considered when determining the effective service life."
18.	ZFX	1	**For all ZFX comments:** Original text is in black Proposed new text is in blue *ZFX notes are in red italics* 1 Scope Original Text: This document covers the machinery, mechanisms, and mechanical attachments used to support flying persons or ride-on flown props, but excludes any connection that relies on the strength or ability of the Flying Performer. Proposed Change: This document covers the machinery, mechanisms, and mechanical attachments used to support flying persons or ride-on flown props, but excludes any connection that relies solely on the strength or ability of the Flying Performer. *The addition of the word "solely" makes it more definitive and less open to*	Accept in principle. Change to: "This document covers the machinery, mechanisms, and mechanical attachments used to support flying persons or ride-on flown props, including attachment to the facility/structural support down to and including the harness or other device that provides direct support for the performer, but excludes any connection that ultimately relies on the strength or ability of the Flying Performer."

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			interpretation.	
19.	ZFX	1	Systems for flying the general public or for people engaged in non-entertainment flying effects are not included in the scope of this document. The use of bungee cord or other elastic lifting medium in the direct load path is outside the scope of this standard. *"Load path" needs to be defined. This is confusing. We unable to offer a suggestion on how to clarify.*	Accept in principle. Add the following to the definitions: "2.24 Load Path: All contiguous mechanical elements that support the flying performer and ride-on prop, if used, up to the supporting structure."
20.	ZFX	3.1	3.1 Intent Original Text: The intent of this section is to define the roles and associated responsibilities involved in performer flying effects. Performer flying can be executed safely only if the various roles and associated responsibilities are clearly understood by all persons involved. There shall be a competent person or persons responsible for the following aspects of the performer flying, unless otherwise noted. A person may take on several of these roles depending on the nature of the flying effect. *This needs at minimum a rewording as it is not factual. Prior to this standard, performer flying has regularly been safely executed without a clear understanding of all of the various roles and associated responsibilities being understood by all of the defined roles listed below. We do not have a suggested rewording and instead suggest the underlined sentence (sentence 2) be removed.*	Accept in principle. Change to: "The intent of this section is to define the roles and associated responsibilities involved in performer flying effects. ~~Performer flying can be executed safely only if the various roles and associated responsibilities are clearly understood by all persons involved~~. There shall be a competent person or persons responsible for the following aspects of the performer flying, unless otherwise noted. A person may take on several of these roles depending on the nature of the flying effect." Add the following to the Annex: "A3.1 Performer flying is safest when the various roles and associated responsibilities are clearly understood by all persons involved."
21.	ZFX	3.11	3.11Observer Original Text: Competent person responsible for observing that the Spotter has correctly performed his/her duties. The Observer may also be responsible for communicating with the Flying Operator(s) or Stage Manager, if stipulated by the Flying Safety Supervisor. The Observer role is not required unless stipulated by the Flying Safety Supervisor or by the Authority Having Jurisdiction. *This needs a definition added to the definitions section. The definition should read: Authority Having Jurisdiction (AHJ): The "authority having jurisdiction" is the organization, office, or individual responsible for "approving" equipment, an installation, or a procedure. (Source NFPA)*	Accept. Add the following definition: "2.2 Authority Having Jurisdiction (AHJ): The organization, office, or individual responsible for approving equipment, an installation, or a procedure." Add Annex note: "A2.2 AHJ: An AHJ is typically the governmental agency or sub-agency which regulates the work, such as a building department, fire marshal, department of labor, health department,

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				OSHA, etc. In most cases, the AHJ is defined by the municipality in which the performer flying installation is located."
22.	ZFX	4.2.6.3	4.2.6.3 (Performer Flying System Design) Original Text: Flying System Designer shall promote redundancy in design to mitigate single point failure points and cascading failures. *This should either be removed since it is not mandatory and will create confusion as to whether single-wire flying is allowed on shows like Peter Pan or it should be followed with the sentence "This does not imply that the use of a single lifting media is prohibited to support the flying performer".*	Accept in principle. Change to: "Flying System Designer shall promote redundancy in design to mitigate single point failure ~~points~~ and cascading failure. In situations where single points or cascading failure points of support are unavoidable, the Flying System Designer shall use a suitably conservative design factor to mitigate risks based on RA/RR."
23.	ZFX	4.2.6.9	4.2.6.9 (Performer Flying System Design) Original Text: Blocks shall be designed or selected as to prevent the lifting media from coming out of the groove in the sheave and becoming jammed between the sheave and the side-plate of the block, or wrapping around the shaft of the drum. *The drum reference should be removed or listed separately since block design doesn't cause the lifting media to become wrapped around the drum shaft.*	Accept in principle. This subject is now covered in Section 4.2.7.5. Change to: "Sheave blocks and drums shall be designed or selected as to prevent the lifting media from coming out of the groove ~~in the sheave and becoming jammed between the sheave and the side-plate of the block, or wrapping around the shaft of the drum~~."
24.	ZFX	4.2.6.10	4.2.6.10 (Performer Flying System Design) Original Text: The grooves in sheaves and drums shall be properly sized for the lifting media being used *(the original sentence ends there but we feel it should continue on as follows)* however using a smaller diameter rope than the optimal grooving is acceptable provided the RA/RR takes into account the potential increased wear on the lifting media, sheaves, and drum. *What exactly is the definition of "properly sized"?* *For 20 years we have almost exclusively used pulleys grooved for 7/32" wire rope using primarily 1/8" wire rope but also 5/64", 3/32", 5/32", and 3/16". This has not presented a problem and has been safely implemented by us on over 5,000 different productions, over 20,000 separately installed systems, over 50,000 performances, which equals millions of cycles. Tests have shown that a larger groove in sheaves or drums than that of the wire rope diameter does not affect the strength of the rope, only its lifespan and*	Accept in Principle. This subject is now covered by Section 4.2.8.4. Text is not changed. Add Annex note: "A4.2.8.4 Proper sizing of grooves in sheaves and drums shall typically follow manufacturer's recommendations and machining standards. Deviations may be permissible if determined by the Flying System Designer using RA/RR, with consideration of rope material and type, cycles, anticipated wear, maximum loads, and maximum operating speed and accelerations."

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			even then by a minute amount if the diameters are close in size. *Because the standard requires daily inspection by competent people in accordance with the manufacturer's written instructions combined with typically very low duty cycles, wear and fatigue prevention should have a limited role in determining the minimum design factors. Our goal is not to have the longest lasting rope, it is to have the smallest diameter rope that we can use safely, and by safely we mean it doesn't fail during its duration of being in service. Sometimes this means to intentionally have a low duty cycle or shorter life in order to use a rope with a smaller diameter. This could very well mean intentionally changing ropes after just ten shows. Additionally although this increases wear on the sheaves, they are inspected just like the rope so wear would be noticed long before it made the sheave structurally deficient.* *Our goal with using the over-sized pulley groove is to produce one model of flying system that accommodates a diverse range of rope diameters. We do the same with grooved drums on hoists and have not experienced any problems with excessive wear between rope changes. Typically the reason for the rope change is that the blackened surface of the rope has lost its black (and therefore become visible to the audience), not that it has suffered a structural deficiency or has exceeded its predetermined duty cycle.*	
25.	ZFX	4.2.7.1.3	4.2.7.1.3 (Component Selection and Design) Original Text: Purchased components selected shall be supplied with a visible load rating mark or certification of its load rating or strength. Proposed Change: Purchased components selected shall be supplied with a visible load rating mark or certification of its load rating or strength, unless components meet the specifications of 4.2.7.1.4. *Otherwise the wording contradicts or prohibits section 4.2.7.1.4.*	Accept in principle. This subject is now covered in Section 4.2.9.1.3. Change to: "Purchased components selected shall be supplied with a visible load rating mark from the manufacturer or certification of its load rating by the manufacturer, unless components meet the specifications of Section 4.2.9.1.4."
26.	ZFX	4.2.7.1.5	4.2.7.1.5 (Component Selection and Design) Original Text: All fasteners shall be non-malleable, steel or stainless steel construction, unless otherwise determined by RA/RR. *Stainless steel fasteners were added since they are used frequently enough that they shouldn't require an RA/RR to determine if they can be used.*	Reject. Stainless steel is a type of steel.
27.	ZFX	4.3.2.9	4.3.2.9 (Analysis) Original Text: For mechanized systems, the risk assessment shall identify all possible ways of triggering emergency stops that are initiated by the Flying Operator, other technicians, Flying Performer, or control system and the	Reject. The clause is general in nature. E-stops can be initiated manually or by mechanism.

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			associated response of the performer flying system. Forces from these emergency stops fall into the category of peak loads. *Addition at beginning of original sentence added since manual system don't have Estops or control systems, therefore they wouldn't be able to comply.*	
28.	ZFX	4.3.3.1.2	4.3.3.1.2 (Analysis) Original Text: Cable track tension lines shall be designed with a minimum design factor of 12X characteristic load and 6X peak load. *What is the statistical basis, historical data, other industry's standards or testing to support the need for this high* *Characteristic Load? This seems overly prescriptive/proscriptive and restrictive. We suggest it reads 10X WLL, 6X Characteristic Load, 3X peak load so it falls in line with other design factors of structural elements noted in this standard: see 4.5.1.2.4, 4.6.5, 4.7.3, and 4.8.4.1.* *Additionally, outdoor tension cable track systems made of steel wire rope are typically long and elevated. This makes them susceptible to lightning strikes, which can greatly weaken the cables and may not be noticed, because this can happen when the system is unattended. Additional RA/RR shall be employed for special inspections to monitor and detect damages caused by lightning.*	Reject. The use of catenary track systems warrants extra care and the design factors proposed reflects this belief. In regards to the comment about lightning, This subject is now covered by Section 4.3.4.1.1 of the document, which already addresses the topic of weather conditions: 'The Flying System Designer shall evaluate self-weight, characteristic and peak loads, and environmental variables imposed on cable track tension lines.' Add the following to the Annex: "A4.3.4.1.2 Maximum tension in tensioned cable tracks is determined using the catenary geometry, cable track pretension, weight of cable tracks, weight of supported performer flying system elements, and the dynamic forces. The selected design factor for supported performer flying system elements in tensioned cable track systems should account for the ability to accurately calculate forces resulting from the often sensitive variables involved in the geometry and forces in a catenary system, hazards caused by a falling tension line, as well as the difficulty often involved in inspecting these systems."
29.	ZFX	4.3.3.2.1	4.3.3.2.1 (Analysis) Original Text: Flying System Designer shall evaluate effects of acceleration, deceleration, and braking torque if mechanized in peak load calculations as applied to the performer flying system and Flying Performer.	Accept in principle. Change to: "Flying System Designer shall evaluate effects of acceleration and deceleration~~, and braking torque~~ in peak load calculations as applied

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			Text added since manual systems don't have brakes.	to the performer flying system and Flying Performer."
30.	ZFX	4.3.3.2.3	4.3.3.2.3 (Analysis) Original Text: *Performer flying systems shall be designed such that loads imposed on the Flying Performer by the harness (characteristic and peak loads) are within the limits specified in the following graphs (Figures 1 through 5) based on definitions of Physiological Accelerations Systems in Table 1. [Graphs derived from ASTM F2291 "Standard Practice for Design of Amusement Rides and Devices" and NASA Memorandum "Human Tolerance to Rapidly Applied Accelerations" by A. Martin Eiband, June 1959.] The graphs indicate that acceleration/deceleration of 2.8G on the Flying Performer is allowed for a maximum duration of 0.2 seconds without regard to Flying Performer orientation relative to motion. *The following NASA graphs should be moved to the appendix.*	Reject. The graphs are part of the mandatory provisions of the standard.
31.	ZFX	4.3.3.2.6	4.3.3.2.6 (Dynamic) Original Text: The surface area pressure of the harness resisting the performer peak load shall not exceed 75 psi. *We suggest this line be removed or replaced with a substantiated amount. What is the statistical basis, historical data, other industry's standards, NASA eyes in-eyes/eye-out type charts, or testing to support this number? We are one of the few companies that manufacture flying harnesses, and have never heard of this guideline.*	Accept in principle. The subject is now covered in Section 4.3.3.1.6. The text will change to the following: "4.3.3.1.6 The surface area pressure of the harness resisting the performer load shall be evaluated during harness design and selection in order to avoid performer discomfort when subjected to characteristic loads and to avoid performer injury when subjected to peak loads." Add the following to the Annex: A4.3.3.1.6 In addition to the effects of G-forces, the flying system designer and harness designer shall consider the effects of pressure exerted on the human body due to point of contact with the harness. The intent being to limit, as much as is practicable, the performer's exposure to bruising, abrasion or general discomfort. Current force values for body harnesses in other industries have been derived from

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				studies of G-forces and the effects of rapid accelerations (both positive and negative) on the human body. Most of these studies were conducted nearly half a century ago and there is surprisingly little modern data available. Most modern studies, white papers and standards reference the Stapp studies conducted in the 1950's. In an effort to determine a threshold of tolerance for the human body due to pressure exerted by forces transmitted through the harness, the task group referenced a variety of scientific studies and white papers listed below. Most notably this except from a 1967 seat belt study that states: "Note that belt forces of 1518-3588 pounds (31.0-74.7 psi belt pressure at .001-.003 seconds duration at 15-23 G on abdomen were found in the Lewis and Stapp tests of volunteers. Only three of these subjects were reported (out of 19) to have received belt bruises in the impingement area, but two others were sore at the lower margin of the rib cage, one for four days, one for two weeks. However, these forces would probably be close to the subjective tolerance limits, since these subjects were all healthy young males. It is important to note that a difference was found in subjective tolerance not only between individuals, but within the same individual on different runs. In similar tests a subjective limit of 9 G was found to be the highest voluntary level in the lateral position (97)."

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				In an attempt of put a maximum value on the pressure exerted by a harness, we looked at both allowable forces in fall arrest harnesses divided across an estimated surface area and compared it with the threshold values stated above. The result being a maximum suggested value of 75 PSI as derived from the force per area calculations and not exceeding the high end of the tolerance scale from the above referenced seatbelt study. This value is offered here as a high limit reference only. The language of this documents does not disallow the manufacturer of flying harnesses from establishing higher or lower thresholds provided proper evaluations and testing is completed that supports the design intent. Suggested Reading: “Seat Belt Injuries in Impact” by R. G. Snyder, Ph.D., and J. W. Young, A. M. of *Ford Motor Company,* C. C. Snow, Ph.D. of *Federal Aviation Agency, and* P. Hanson, M. S. of *6571st Aeromedical Research Laboratory, USA F. Reprinted from* THE PREVENTION OF HIGHWAY INJURY *from The Proceedings of a Symposium held in honor of The University of Michigan's Sesquicentennial Celebration and sponsored by the University's' Medical School and Highway Safety Research Institute.* April 19-21, 1967. *Published by* HIGHWAY SAFETY RESEARCH INSTITUTE, The University of Michigan, 1*967.*

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				"Survivable Impact Forces on Human Body Constrained by Full Body Harness" HSL/2003/09, Prepared by Harry Crawford for the Health and Safety Executive (http://www.hse.gov.uk/) "Human Tolerance and Crash Survivability" by Dennis F. Shanahan, M.D., M.P.H., Injury Analysis, LLC, 2839 Via Conquistador, Carlsbad, CA. *Paper presented at the NATO Research and Technology Organization Human Factors and Medicine Panel (RTO HFM) Lecture Series on "Pathological Aspects and Associated Biodynamics in Aircraft Accident Investigation," held in Madrid, Spain, 28-29 October 2004; Königsbrück, Germany, 2-3 November 2004, and published in RTO-EN-HFM-113.*
32.	ZFX	4.3.3.2.7	4.3.3.2.7 (Dynamic) Original Text: Flying System Designer shall evaluate effects of peak load tension on cable track line attachments points. *F should be added to Lying, unless this was in fact referencing to Lying Systems Designers which we do not dispute the existence of, but think a more politically correct reference would be "truthfully challenged" or "intentionally factually inaccurate" or "misleading" or simply just "douchebag" [don't let this distract from the seriousness of the other comments]*	Accept grammatical change.
33.	ZFX	4.4.1	4.4.1 (Engineering Documentation) Original Text: Engineering drawings of the structural, mechanical, and electrical elements, and general arrangement drawings of the performer flying system, shall be developed and maintained by the Owner and furnished to the User upon request. *The original sentence ended with "User" we added "upon request" otherwise it is mandatory to proactively give all of the documents to the User every single time, which if not required by the User, is an unnecessary use of resources.*	Accept in principle. Change to: "Engineering drawings of the structural, mechanical, and electrical elements, and general arrangement drawings of the performer flying system, shall be developed and maintained by the Owner ~~and furnished to the User~~."
34.	ZFX	4.5.1.2.4	4.5.1.2.4 (Personal Flying Equipment)	Accept in principle. Change to:

#	Commenter	Clause	Comment	
			Original Text: Performer flying harnesses shall be selected with a minimum design factor of 10X WLL, 6X characteristic load and 3X peak load. *The original word "design" was changed to "selected" since the majority of performer flying harnesses are mass-produced, commercially-available, stock items, and therefore they are not designed specifically for one instance, rather they are "selected" by a qualified person. There are times when harnesses are custom built for one instance and therefore these design factors will be taken into account, but this should not require an additional clause specific to Custom Built Harnesses.*	"Performer flying harnesses shall be designed and selected with a minimum design factor of…".
35.	ZFX	4.5.2.4	4.5.2.4 (Ride-On Props) Original Text: All Flying Performers riding on or in flying vessels, platforms, or props shall be tethered directly to the load path. *At a minimum, "Load Path" needs a definition. We would also like further clarification on the following: If this standard means that performers need to be tethered directly to the lifting media as opposed to the vessel, platform, or prop (VPP), then this clause should be removed altogether. If the VPP is built to comply with the criteria specified in this document to fly performers, then why is the VPP not safe enough to tether the performer to as a restraint against falling (i.e. a seatbelt)? The logic for tethering to the lifting media (as opposed to the VPP) is not sound. Do the various substructures of the VPP then have to be individually tethered to the "Load Path" if the VPP is flying above people and if they aren't structurally sound enough to directly support the performer/s? If there is a concern about VPPs being built to a level of structural integrity to sufficiently support a performer, should people then be banned from being directly beneath these VPPs? Additionally what if our RA/RR shows that tethering the performer to the load path is less safe than tethering them directly to the VPP? If the concern is that the VPP would not be structurally sound enough to withstand the shock of restraining a falling performer, then the solution should be to increase the design factor of the VPP itself.*	Accept in principle. Add the following to the definitions, which clarifies the proper support of the flying performer: "Load Path: All contiguous mechanical elements that support the flying performer and ride-on prop, if used, up to the supporting structure. Portions of the ride-on prop that directly support the flying performer to the lifting medium shall be considered part of the load path."
36.	ZFX	4.6.2	4.6.2 (Quick-Connect Hardware) Original Text: All quick-connect hardware shall require at least two separate and/or sequential actions to open/unlock. The number of required separate actions shall be determined by RA/RR. *The original word "simultaneous" was replaced with separate and/or sequential, since both actions would have to happen at the same time and*	Accept in principle. Change to: "All quick-connect hardware shall require at least two ~~simultaneous~~ actions to open/unlock. These actions can be simultaneous or sequential. The number of required ~~simultaneous~~ actions shall be determined by RA/RR."

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			some dual-action quick connect harness connections can't in fact happen simultaneously.	
37.	ZFX	4.6.5	4.6.5 (Quick-Connect Hardware) Original Text: Quick-connect hardware shall be selected with a minimum design factor of 10X WLL, 6X characteristic load and 3X peak load. *The word "design" was changed to "selected" since the majority of quick-connect hardware are mass-produced commercially-available, stock items, therefore quick-connect hardware items are not designed for one instance, rather they are "selected" by a qualified person. There are times when quick-connect hardware may be custom built for one instance and therefore these design factors will be taken into account, but should not require an additional clause specific to Quick-Connect Hardware.*	Accept in principle. Change to: "Quick-connect hardware shall be designed and selected with a minimum design factor of…"
38.	ZFX	4.7.2	4.7.2 (Other Load-Bearing Hardware) Original text: Purchased hardware must bear a load rating that is permanently marked on the hardware. Proposed change: Purchased load-bearing components, fasteners, or hardware must either have a marked load rating, grade rating, or have an identifying marking that correspond to catalog listed ratings, or be supplied with documentation of its strength, working load limit, or ultimate breaking strength. *Hardware needs a definition, it has not been defined in this standard. Does it include shackles and quicklinks or is it nuts and bolts? If it includes the latter, none of them are permanently marked with a load rating. Fasteners such as bolts have only an indicator of grade. Machinery eyebolts made by Chicago Hardware and Fixture Company only have a model number and manufacturer's name, not a permanently marked load rating.*	Accept in principle. Change to: "Purchased load-bearing hardware must either have a marked load rating, grade rating, or have an identifying marking that correspond to catalog listed ratings, or be supplied with documentation of its strength, working load limit, or ultimate breaking strength." Add the following to the definitions: "**load-bearing hardware:** Purchased elements, such as fasteners, rigging components, and equipment, which are part of the load path."
39.	ZFX	4.7.3	4.7.3 (Other Load-Bearing Hardware) Original text: Hardware shall be selected with a minimum design factor of 10X WLL, 6X characteristic load and 3X peak load. ' *The word "design" was changed to "selected" since the majority of hardware are mass-produced, commercially-available, stock items, therefore hardware items are not designed for one instance, rather they are "selected" by a qualified person. There are times when hardware may be custom built for one instance and therefore these design factors will be taken into account, but should not require an additional clause specific to Hardware.*	Accept in principle. Change to: "Hardware shall be designed and selected with a minimum design factor of…"
40.	ZFX	4.8.1.3	4.8.1.3 (Material)	Accept in principle. These documents are

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			Original text: The material chosen for the lifting medium must be furnished with mill or manufacturers certification documents detailing the base materials used in manufacturing, the origin and location of manufacture, and quality control and quality assurance testing methods and results. These documents shall be included in the documentation package available upon request. *Text of "available upon request"added, otherwise it is mandatory to proactively give all of the documents to the User every single time, which if not required by the User, is an unnecessary use of resources*	not required to be furnished to the User. The text will be altered as follows: "The material chosen for the lifting medium must be furnished with mill or manufacturers certification documents detailing the base materials used in manufacturing, the origin and location of manufacture, and quality control and quality assurance testing methods and results. These documents shall be included in the documentation package maintained by the Owner."
41.	ZFX	4.8.2.1	4.8.2.1 (Terminations) Original Text: All terminations shall be made in accordance with manufacturer specifications, rigorously tested, or proven industry methods. *Text of "rigorously tested, or proven industry methods" has been added to the end. We do a slight deviation of the crimping technique from the manufacturer's specifications when using the Nicopress that we have subjected to rigorous testing, and used tens of thousands of times without incident. As this clause was originally written, we would be precluded from doing such. Additionally, the Nicopress manufacturer's specifications (the instruction manual), says to "use the gauge furnished with the tool" to inspect, which would mean if you lost that gauge, you would have to buy a new tool and gauge, since the manual only makes provisions to use the originally supplied gauge. This may just be semantics, but to be in compliance with this standard, the letter of the law would state this case. Separately, we have developed our own rigorously tested gauge and do not use the one supplied. We have had numerous conversations with the Nicopress company about using our proprietary gauge, and have received their tacit approval, but as one can easily imagine in this litigious society, we are unable to get the use of this included in the manufacturer's specifications. Furthermore, in the spirit of clause 4.2.6.6, "…the Flying System Designer shall use RA/RR to determine appropriate use and takes on full responsibility for this use," some mechanism for deviation from the manufacturer's specifications should be allowed. As originally written, this clause would prohibit us from using the alternate method of crimping or from using our proprietary gauge to inspect.*	Reject. Section 4.1 allows variations based on RA/RR or review and approval by a professional engineer.

Approved resolutions to comments received during the first public review of BSR E1.43

#	Commenter	Clause	Comment	
42.	ZFX	4.8.4.1	4.8.4.1 (Strength Design Factors) Original Text: Flexible lifting media (e.g., rope, chain, band, webbing) shall be designed with a minimum design factor of 10X WLL, 6X characteristic load and 3X peak load. Proposed Change: Flexible lifting media (e.g., rope, chain, band, webbing) shall default to a design factor of 8X WLL, 4X characteristic load and 3X peak load. These numbers can be modified as determined by RA/RR. This standard is being created to set the minimum level of design factors. We consider clause 4.8.4.1 to be overlyrestrictive for the following reasons: #1 an 8X WLL limit is statistically and historically shown to be safe. #2 because the peak load is taken into account to analyze dynamic situations, the WLL and CL (Characteristic Load) design factors need not be so high. #3because the standard requires daily inspection by competent people in accordance with the manufacturer's written instructions, combined with typically low duty cycles, wear and fatigue should not play a role in adding to the factor number (10X, 6X, 3X) #4 the most common use of performer flying is to give the illusion of flight (when you can see the wires, there is no illusion) and this will no longer be possible in many instances that currently do not have a history of being unsafe. #5 provides no provision for lower WLL in very controlled situations where the RA/RR would deem it safe. #6 OSHA deems using cranes to lift people as dangerous and therefore requires extra-stringent precautions, one of which is an increased safety factor on the wire rope to 7. We suggest clause 4.8.4.1 be rewritten as follows: "Flexible lifting media (e.g., rope, chain, band, webbing) shall default to a design factor of 8X WLL, 4X characteristic load and 3X peak load. These numbers can be modified as determined by RA/RR." *Our arguments for the six bullet points listed above are as follows:* *#1- An 8X WLL limit is statistically and historically shown to be safe. For the last 20 years we (ZFX Inc) have defaulted to a design factor on WLL of 8, which is then modified by RA/RR as needed. This design factor has not presented a problem and has been safely implemented on over 5,000 different productions, over 20,000 separately installed systems, and over 50,000 performances, which equals millions of cycles. There has never been an instance for us where a design factor of 8 has caused an incident.*	Reject. Higher design factors for flying people is warranted relative to overhead rigging of objects. 10:1 design factor on WLL is commonly used in the industry. This factor is 20% larger than the 8:1 WLL design factor specified for overhead rigging in ANSI E1.6-1. Similarly, the design factors for characteristic and peak loads have been scaled up by 20% relative to E1.6-1 values. OSHA 1926.550 Part G referenced by the Commenter pertains to personnel on specifically-designed work platforms and does not include the dynamic characteristics of performer flying. For reference, Section 4.1 allows variations based on RA/RR or review and approval by a professional engineer.

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			Additionally because of my apprenticeship and four year tenure with Foy Inventerprises (1990-1994), I am aware of an additional estimated 1,300 productions done by Foy during that period that used a similar 8X WLL and RA/RR also without incident caused by too low of a WLL. *#2- Because the peak load is taken into account to analyze dynamic situations, the WLL and CL (Characteristic Load) design factors need not be so high. We infer that the purpose of the WLL, CL and PL (Peak Load) are used to ensure that one rule can apply safely to very different scenarios. This clause is what will be used to determine the minimum size of the flexible lifting media, which we will discuss in terms of rope diameter.* *The controlling factor on rope size for a manual flying system (people pulling ropes) with slow dynamic flights (Wendy flying onstage into Neverland in Peter Pan) would be the WLL, not the CL or PL. Since the system is manual and peoplepowered, there are no mechanical brakes to suddenly stop motion; the lift operator can't exert a force greater than their mass on the lift rope, and power outages have no effect on the flying system. Therefore the only difference between PL and CL is what forces/speeds there are during the actual flight and how much faster the operator could be physically capable of going. That being said, a typical "docile" flight has a CL of 1.3X the PM (performer's mass/weight). Let's say for the sake of argument the PL is higher (since we have an understudy lift operator with more muscle and mass who gets excited and doesn't follow the choreography very well), so it is determined that the PL is 1.5X the PM. It would come down to the WLL design factor being the higher number between 8X the PM versus the CL of 5.2X (4X x 1.3), or the PL of 4.5 (3X 1.5). As we spelled out in point #1, a design factor of 8 for the WLL has been shown to be safe.* *At the other end of the flying spectrum are high speed hoists that are measured in MPH, not Ft/s, which can have sudden power loss or an Estop that immediately closes the two brakes. For this scenario the WLL would not be the deciding factor for the size of the rope; it will be the PL. You could have a low WLL design factor and it can still be safe, since the PL would be 3-5X the PM. If the rope is sized to be 3X the PL, it would be 9X-15X the PM, which is much higher than the WLL equaling 8X the PM. In this scenario a low WLL does not conflict with determining a safe rope diameter.* *#3-Because the standard requires daily inspection by competent people in accordance with the manufacturer's written instructions combined with typically very low duty cycles, wear and fatigue prevention should have a limited role in determining the minimum design factors. Our goal is not to*	

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			have the longest lasting rope, it is to have the smallest diameter rope that we can use safely, and by safely we mean doesn't fail during its duration of being in service. Sometimes this means we will intentionally have a low duty cycle or shorter life in order to use a rope with a smaller diameter. This could very well mean intentionally changing ropes after just four shows. *Since the standard requires daily inspections of the system and its flexible lifting media by competent persons in* *accordance with the written instructions from the flying system manufacturer, a higher WLL is not necessary to offset unnoticed wear from infrequent inspections. It seems illogical for this standard to require daily inspections and high WLLs to take wear into account while the ANSI E1.4-2014 standard requires a design factor of 8X for wire rope and at minimum only an inspection once a year. Synthetic and wire ropes show clear signs as they wear and any issues with the FLM (Flexible Lifting Media) would be detected through thorough daily inspections. Using a lower WLL requires more frequent maintenance, but as long as there are daily inspections, daily load tests and frequent changes of the wire ropes, we don't see this being an issue.* *The most frequent use of flying effects in the USA is in theatrical productions that last less than 10 performances, with the flying system installed for 3 weeks or less. We work on over 300 productions annually that fit within those parameters. We conservatively estimate that we cover 33% of the market, so combined with our competitors in the area of theatrical flying effects (Foy, Hall, D2) that is roughly 900 productions, all with low duty cycles. Our experience is that wire ropes do not show wear at the completion of these types of productions. Therefore they should not be required to meet a higher WLL design factor as may be required on long or indefinitely running productions.* *#4-the most common use of performer flying is to give the illusion of flight and this will no longer be possible in many instances, despite many productions with no history of being unsafe. Whereas an argument could be made that if a design factor of 8X is safe then why not go to 10X, doing that would require us to use larger sized flexible lifting media, which would destroy the end result of what we do, namely to provide the illusion of flying to theatrical productions. In stunt work the wires are digitally edited out, and in spectacle flying (Cirque du Soleil type) seeing the wires does not distract, but in theatrical flying (Peter Pan) we are expected to use the smallest safe wire rope in order to complement and not distract from the visual illusion of*	

#	Commenter	Clause	Comment	
			flight. *The most common lifting media that we use is a 1/8" blackened stainless steel aircraft cable with a published breaking strength of 1,760lbs. Using a safety factor of 10X would limit the WLL limit to 176lbs. This would mean that if the performer playing Wendy weighs 185lbs (She has a great voice plus her parents donated lots of money) who will be suspended from a single line (as are all flying systems used for 99% of the productions of Peter Pan) would have to use 5/32" diameter wire rope. Close to half of the venues where we install manual flying systems have conditions that require us to hang the flying system too low to be able to have in-view flexible lifting media (4.8.4.2) that would not run over pulleys. Therefore using 5/32" in the flying system and 1/8" on the in-view lifting media would not work.* *The ability to make the wires disappear to the audience with the assistance of cooperative lighting and scenic design pretty much becomes impossible using 5/32". We have found that wire rope diameters up to 1/8" can used to achieve the illusion of flight in the right conditions, 5/32" simply cannot. Again as we explain in point #1, an 8X WLL has never been shown to be a safety issue in our productions.* *We could ask the performer to lose weight but that would just be mean.* *#5–The provision for a lower WLL (in very controlled situations where the RA/RR would deem it safe) needs to be expressly included in 4.8.4.1 so that there is no possibility of misinterpreting clause "4.1 Intent" in a way that does not allow for the possibility of a lower WLL. Although it happens infrequently, there are situations where WLL design factors of 5X or even 4X are safe. An example would be with a single vertical flight on a simple pendulum system elevating the performer 8', ascending in a very slow manner during an event that has a single performance. Including FAT, CAT, and SAT there might be 50 cycles of use. Based on an RA/RR it may be deemed that in this instance a WLL of 5X is safe, however as originally written there is no openly stated way to deviate from the minimum requirements listed. The RA/RR should really be the determining factor in the WLL design factors.* *#6-OSHA deems using cranes to lift people as dangerous and therefore requires extra stringent precautions, one of which is an increased safety factor on the wire rope to 7X. Why would a flying system specifically designed by qualified individuals for the sole purpose of flying people and pass a formal RA/RR process need a higher design factor than 7X as its minimum requirement when OSHA feels that a safety factor of 7X on wire rope is acceptable in situations where people are supported from a single*	

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			wire rope (cranes typically have only one rope) in situations OSHA expressly says "constitutes a significant hazard"? The following three paragraphs are copied directly from OSHA's website, the final sentence states the safety factor. Full article can be found at: https://www.osha.gov/doc/outreachtraining/htmlfiles/cranplat.html *Personnel platforms that are suspended from the load line and used in construction are covered by 29 CFR 1926.550(g). In addition, there is no specific provision for suspended personnel platforms in Part 1910. The governing provision, therefore is general provision 1910.180(h)(3)(v), which prohibits hoisting, lowering, swinging, or traveling while anyone is on the load or hook. OSHA has determined, however, that when the use of a conventional means of access to any elevated worksite would be impossible or more hazardous, a violation of 1910.180(h)(3)(v) will be treated as "de minimis" if the employer has complied with the provisions set forth in 1926.550(g)(3), (4), (5), (6), (7), and (8).* *The OSHA rule prohibits hoisting personnel by crane or derrick except when no safe alternative is possible. Based on the review of the record, OSHA determined that hoisting with crane- or derrick-suspended personnel platforms constitutes a significant hazard to hoisted employees and must not be permitted unless conventional means of transporting employees are not feasible or unless they present greater hazards. OSHA determined that compliance with the provisions of this standard will provide the best available protection for personnel being hoisted by these platforms in those limited situations where such hoisting is necessary.* *The crane operator must always be at the controls when the crane engine is running and the personnel platform is occupied. The crane operator also must have full control over the movement of the personnel platform. Any movement of the personnel platform must be performed slowly and cautiously without any sudden jerking of the crane, derrick, or the platform. Wire rope used for personnel lifting must have a minimum safety factor of seven.*	
43.	ZFX	4.8.5.2 Dana	4.8.5.2 (Fatigue Factors) In the case of flexible lifting media, the diameter, quantity, and relative position of the sheaves and rollers in the performer flying system shall be used to determine the number of fatigue cycles on the material during each operation. *There is no definition for "fatigue cycles", and we think it should instead read "*number of allowable duty cycles (or cycle)."	Accept in principle. This subject is now covered in Section 4.8.9. Add definition: "2.28 Operating cycles: One complete series of motions consisting of a move in one direction followed by a move in the

#	Commenter	Clause	Comment	
				opposite direction. Programmed cues may consist of multiple operating cycles in one motion profile." The following will be added to section 4.2.6.4: "The Flying System Designer shall determine the anticipated operating cycles for the flying system." The following changes will be made: 4.8.1.2 ~~"The material chosen for the lifting medium shall be selected to meet the service life requirement based on the expected~~ number of operating use cycles ~~during its life~~ duty cycle, ~~the required availability of the system, and maintenance schedule of the performer flying system~~. "The lifting media selection shall consider the anticipated number of operating cycles and inspection and maintenance frequency." 4.8.9.1 "Cycles: Use the number of bend and loading cycles to determine the expected service life of lifting medium elements. Service life is determined by multiplying the number of bending/loading cycles on the lifting medium during each operation by the anticipated total number of operations, which include testing, rehearsal, maintenance, and performance. ~~The expected duty cycle of the equipment shall be used to determine the number of bend and loading cycles in order to determine the number of fatigue cycles on the lifting medium elements~~."

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				4.8.9.2 "Diameter and quantity of sheaves and rollers: ~~In the case of flexible lifting medium, the diameter, quantity, and relative position of the sheaves and rollers in the performer flying system shall be used to determine the number of fatigue cycles on the medium during each operation.~~ In the case of flexible lifting medium, the quantity and relative position of the sheaves and rollers in the performer flying system shall be used to determine the number of bending fatigue cycles on the lifting medium during each operation. The number of bending fatigue cycles, the number of changes bend direction, and the D/d ratios shall be considered when determining the effective service life."
44.	ZFX	4.9.1.1	4.9.1.1 (Strength) Equipment support frames and static load bearing components shall be designed with a minimum design factor of 6.67X WLL, 4X characteristic load and 2X peak load. *This definition is vague. We are unsure what this standard does and does not include, therefore we cannot easily meet this standard without further clarification.* *We feel that this term is broad enough to possibly include slings, rigging steel, building truss frames, manufactured truss frames, I beams, and/or chain motors, as well as many other supporting media.*	Accept in principle. Change the following: "4.9 ~~Equipment Support Frames and~~ Static Load Bearing Components." "4.9.1.1 ~~Equipment support frames and~~ Static load bearing components shall be designed…" The following is added to the Annex: "A4.9 Static load bearing components. This elements include but are not limited to winch frames, equipment support frames, sheave block support frames, carrier support tracks, support brackets, support trusses."
45.	ZFX	4.10.1.2.2	4.10.1.2.2 (Electromechanical Actuation) The purpose of the load securing devices shall be to independently secure the load at any position. One device shall be directly coupled to the drum or other termination point of the lifting medium. The second device may be located anywhere in the power transmission system.	Reject. The text does not state that the brake is directly mounted to the drum; it states that the brake is directly coupled to the drum.

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			The original wording is confusing. By saying one device needs to be "directly coupled to the drum," which seems to eliminate any method other than a caliper brake on a large lip or rim physically part of the drum and the other option of "termination point of the lifting media." This would indicate that it should be connected to the point where the lifting media would terminate to the drum. We are not sure how this would work with the latter option. We believe it was the author's intention in laymen's terms to have at least one brake that is post gearbox (output side) either directly coupled with a caliper-style brake clamping a flange that is physically part of the drum, or a brake that is connected to the drum shaft. This is overly prescriptive/proscriptive and could be interpreted as a way to inhibit trade. *Additionally, if the argument for this is in the event of the motor shaft, coupling or gearbox interior should break, what about the single drum shaft? The clause doesn't say where the drum brake should go, if it is mounted between the gearbox and drum what happens if instead of the motor shaft breaking, the drum shaft breaks between the brake and the drum? The hoist has no way to stop the load. If instead this is changed to move the drum brake so it is opposite of the drum from the gearbox, then half of the performer flying hoists used in this industry will no longer comply.* *Furthermore, whereas an argument can be made that the drum shaft is frequently over-sized and thus not likely to fail, the same argument could apply to the gearbox or motor.* *We do not currently make hoists that have both brakes on the motor side, and have no affiliation with XLNT and their Cyberhoists (in fact they are an infrequent competitor) or other mainly German companies (such as Think Abele's Movecat) both of whom also produce chain hoists rated for flying people that have two brakes both on the motor side of the gearbox. These chain hoists have had rigorous testing and meet strict German standards and are TUV (an internationally accepted testing body) certified. We don't see why their products should be prohibited. The German standard BGV-C1 and DIN 96950 (5.2.6.1) has shown no sign of being lax on safety, and only requires two independent load supporting devices, without specifying where they are to be located. We suggest the entire second and third sentences of this standard be removed.*	None of the overly prescriptive assumptions stated in the Commenter's examples are implied in the wording of this clause. In fact, the wording in the standard is intentionally non-prescriptive to facilitate variation in design. All of the failure mode scenarios presented are certainly of concern and can be mitigated in the design of the machinery.
46.	ZFX	4.10.2.2.1	4.10.2.2.1 (Control Functions) Original Text: Normal limits shall not be utilized in normal operation of the performer flying system if it has soft limits, except when used as part of the homing procedure without the Flying Performer.	Reject. Section 4.1 allows variations based on RA/RR or review and approval by a professional engineer.

#	Commenter	Clause	Comment	
			Text of "if it has soft limits" added to the original sentence. Some mechanized single axis systems are not automated and have no encoder feedback (such as simple aerialist hoists) and therefore have no way to control its position without using the limit switches. They are controlled by an operator using a joystick pendant and they frequently use the normal up limit (vertical) as a stopping point for its normal use. Additional RA/RR is used in determining where that up limit is set. How can a hoist with no encoder be controlled without using the limit switches?	
47.	ZFX	4.10.2.2.10	4.10.2.2.10 (Control Functions) Original Text: When multiple actuators are used to perform an individual flying effect, the actuators shall be capable of being linked by the control system so that any fault shall stop motion of all actuators for that individual effect, provided the RA/RR deems it necessary. *The words "capable of being" are added to the original sentence. In some compensated tracked systems, for instance, having all axes suddenly stop when just one axis faults can create a more dangerous situation than not stopping, so this should not be written as an absolute mandate, but instead determined by RA/RR.*	Accept in principle. Change to: "When two or more actuators are used to perform an individual flying effect, and the fault of one of the actuators puts the flying performer at risk of harm, the actuators shall be linked by the control system so that any fault shall stop motion of all actuators for that individual effect."
48.	ZFX	5.4.1.1	5.4.1.1 (Torque) Original Text: Fastener torque requirements and torque values shall be determined by the Flying System Designer. After applying the proper torque, fasteners shall be marked with a painted stripe across the nut or fastener head and bearing surface to indicate that the fastener has been tightened properly, and to indicate slippage or loosening in service, as deemed necessary by the Flying System Designer. *The words "or fastener head" were added since there is no nut when using a bolt or screw in a blind or tapped hole. Text of "as deemed necessary by the Flying System Designer" was added because some fasteners simply don't need to be torqued or marked, and this will add a time consuming step. For instance we annually use tens of thousands of #10 button-head cap screws to connect plastic cheek plate inserts and they have a very low torque spec and are screwed into a naturally vibration resistant plastic. We have installed over 100,000 of these screws and have not had a single instance of one coming loose. We do not feel that these need a paint stripe and view it as a costly additional step, literally doubling our assembly time for these non-load bearing items. Additionally, the original text does not distinguish between*	Accept in principle. Change to: "Fastener torque requirements and torque values shall be determined by the Flying System Designer. After applying the proper torque, fasteners shall be marked with a painted stripe across the nut or fastener head and bearing surface to indicate that the fastener has been tightened properly, and to indicate slippage or loosening in service, except at locations specifically excluded from striping by the Flying System Designer."

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			where the fastener is used. For instance, would this include every one of the terminal screws in the electrical panel of automated controls? They are fasteners that have a torque spec, but no way to provide a paint mark.	
49.	ZFX	5.8.1.3	5.8.1.3 (General Requirements) Original Text: The system manual shall be composed of an operation section and a maintenance section. The system manual may be bound in multiple volumes, or exist electronically such as in PDF format. *The final text added since there is no reason in the modern world these need to be paper documents. Get green, people, the future depends on you!*	Accept. Change to: "The system manual shall be composed of an operation section and a maintenance section. The system manual may be bound in multiple volumes, or exist electronically such as in PDF format."
50.	ZFX	5.8.2.1.2	5.8.2.1.2 (Operational Documentation) Original Text: Descriptions of fault indications, including system responses and corrective procedures, when applicable. *Final text added since manual systems aren't capable of having Faults*	Accept. Change to: "Descriptions of fault indications, including system responses and corrective procedures, when applicable."
51.	ZFX	5.8.4.2	5.8.4.2 (Destructive) Original Text: All destructive testing documents shall be kept on file and made available to local AHJs if requested. *AHJ is not defined, see previous note on 3.11*	Accept in principle: Add the following definition: "Authority Having Jurisdiction (AHJ): The organization, office, or individual responsible for approving equipment, an installation, or a procedure." Add Annex note: "An AHJ is typically the governmental agency or sub-agency which regulates the work, such as a building department, fire marshal, department of labor, health department, OSHA, etc. In most cases, the AHJ is defined by the municipality in which the performer flying installation is located."
52.	ZFX	5.8.4.3	5.8.4.3 (Certifications) Original Text: Purchased load-bearing components supplied by component manufacturers shall bear a visible load rating mark or shall be supplied with a certification of their load rating or strength. *The text "load-bearing" was added since, as written, the original text would require this of all purchased components. All purchased components that are part of the system are not in fact load-bearing, so to obtain certifications of strength or statements that the part has no known strength (nor needs one*	Accept. This subject is now covered in Section 5.8.5. Change to: "Purchased load-bearing hardware and components supplied by component manufacturers…"

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			due to its function), would be difficult and not relevant.	
53.	ZFX	6.1.3	6.1.3 (Intent) Original Text: The performer flying system shall be installed by or under the direct supervision of a qualified person. *The words "by or" were added, otherwise it would require a minimum of two people to install.*	Accept. Change to: "The performer flying system shall be installed by or under the direct supervision of a qualified person."
54.	ZFX	6.5.4	6.5.4 (Commissioning Testing) Original Text: Tests of normal and ultimate limits shall be conducted using WLL at full speed in both directions, except as follows: For optimal testing of vertical axis limits (up direction on a hoist), it should be done at full speed with a minimal load to test weight that is lighter than the WLL. *Heavier loads do not coast as much as small loads in this situation, and therefore using the full WLL would not accurately test the limits.*	Accept in principle. Change to: "Tests of normal and ultimate limits shall be conducted using both WLL and minimum anticipated load at full speed in both directions, except as follows:"
55.	ZFX	7.8.4	7.8.4 (Rescue Team) Original Text: A complete rescue team, including the Incident Commander, Rescue Rigger(s) and First Aid Attendant, shall be in attendance whenever a person is flown. Proposed Change: A complete rescue team including an Incident Commander and Rescue Rigger(s) shall be in attendance whenever a person is flown. All Rescue Team members shall have full knowledge of the First Aid Plan before any flying may take place. The need for a First Aid Attendant shall be determined by RA/RR. *[A First Aid Planis defined as a pre-determined course of action to obtain First Aid services from trained personnel, and should perhaps be included in the definition section.]* *Hiring additional personnel with the qualifications needed to be a First Aid Attendant may put undue financial burden on the User (our clients). It is also overly prescriptive/proscriptive and is not required for day to day operations in a normal theatrical production, which statistically speaking has a higher occurrence of incidents than does performer flying. For example, although falling from elevated platforms is just as dangerous and happens with greater frequency, a First Aid Attendant is not a requirement in DRAFT BSR E1.46 - 201X Revision of 29 RECOMMENDED PRACTICE FOR THE PREVENTION OF FALLS FROM THEATRICAL STAGES AND RAISED PERFORMANCE PLATFORMS, nor is it a requirement from OSHA when moving people with cranes which it expressly states "exposes a significant risk to employees." However, OSHA allows (see OSHA reference information in our notes*	Reject. This subject is now covered in Section 7.9.4. First Aid Attendant is not necessarily an addition person; instead, this is a role that is needed whenever a performer is put in a risky situation by flying.

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			regarding 4.8.4.1) movement of people with cranes in certain conditions, provided various risk reductions are included – none of which are a First Aid Attendant being present.	
56.	ZFX	8.2	8.2 (Documentation) Original Text: Items that are to be reused and placed in storage or transported between applications shall be inspected for defects and documented by a competent person before being re-used. *The original text of "stored and transported" was changed to "re-used" since the original wording was overly prescriptive/proscriptive. Our re-used items are inspected before 'being re-used' (prior to FAT), as opposed to before 'being stored,' and we have had no issues as a result of this.*	Accept. Change to: "Items that are to be reused and placed in storage or transported between applications shall be inspected for defects and documented by a competent person before being ~~stored or transported~~ reused."
57.	ZFX	8.3	8.3 (Environmental Conditions) Original Text: Items shall be stored in an environment as per the System Supplier's recommendations. All items shall be kept free from harmful exposure to high humidity and damp conditions, corrosive contaminates, ultraviolet radiation, abrasive wear, high temperatures for fiber materials, and high or low temperature extremes for plastic parts. Proposed Change: The System Supplier shall prescribe how these items should be stored, and what could be harmful to the components. These conditions may include (but are not limited to) being exposed to high humidity and damp conditions, corrosive contaminates, ultraviolet radiation, abrasive wear, high temperatures for fiber materials, and high or low temperature extremes for plastic parts. *This should be re-worded since some of those conditions such as dampness may have no negative effect what so ever on some items. The structure of the original two sentences could imply that those conditions are always harmful to all items.*	Accept in principle. Change to: "The System Supplier shall prescribe the requirements for storage and define what environmental conditions could be harmful. These conditions may include, but are not necessarily limited to: exposure to high humidity and damp conditions, corrosive contaminates, ultraviolet radiation, abrasive wear, high temperatures for fiber materials, and high or low temperature extremes for plastic parts."
58.	JSD	General	This is a general comment and response for consideration by the Task Force. I apologize in advance for both the length and the broad-brush nature of these comments. I hope they are helpful. I have been following the work of the task force with great interest since it began its work, and I applaud enthusiastically the direction the task force has taken. I believe it will make a significant and positive difference, contributing to the adoption of safer practices and improved risk management. I have a particular interest in parts of the industry that are not historically a	Accept in principle. The scope section has been modified as follows, noting that several sentences have been repositioned but not changed: 2nd paragraph: "Performer flying systems within the scope of this standard include devices and systems supporting people or components to which people are attached, suspended in the air that give the

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			part of the mainstream, including aerial circus, acrobatic, and dance rigging. These disciplines have grown dramatically and explosively in the recent past, and the quality of rigging practices varies widely. While I am involved in many aspects of entertainment rigging, I have spent a good part of the past decade working with aerial performance practitioners to help improve these practices. Today, there is an emerging and broadly-based recognition that better practices and baseline standards are needed. As a point of information, the Safety in Aerial Arts Facebook Group now has over 2,000 members, and the ongoing discussions and questions raised demonstrate both strong interest and a clear need. The Task Force has done an excellent job identifying key issues, principles, and practices that will make a real difference and will, I am confident, save lives. Particularly important are the emphasis placed on risk analysis and risk management, and the excellent analytical work and distinctions relating to dynamic loading and design factors. There are people who, upon reading the draft standards, have said to me that they seem to be written very narrowly and specifically with a focus on theatrical performer flying, and within that sphere with an emphasis on large-scale and complex automated systems. They have pointed out that typical circus, acrobatic, and dance scenarios are not addressed directly except in the scope, and that many of the provisions of the standards either do not or should not apply to those arenas. There is some truth to this, although I believe that by and large, the general principles and approaches being taken by the task force are equally applicable to all entertainment rigging where human performers are up in the air. In public discussions since the draft was issued for public comment, some have suggested that circus and acrobatic rigging be excluded entirely from this standard. This would be entirely the wrong approach, both because it would miss the opportunity to enhance safety in areas where enhancement is needed, and because it would create a confused and confusing situation. If I am a rigger putting a performer-person in the air as part of an entertainment	impression of weightlessness, floating, flying, or descending~~, and for acrobatic and circus performance acts~~. Situations covered by this standard pertain to any and all locations of the flight path, including over the stage or audience." 3rd to 5th paragraphs: "This document covers the machinery, mechanisms, and mechanical attachments used to support flying persons or ride-on flown props, <u>including attachment to the facility/structural support down to and including the harness or other device that provides direct support for the performer</u>, but excludes any connection that <u>ultimately</u> relies on the strength or ability of the Flying Performer. The use of bungee cord or other elastic lifting medium in the direct load path is outside the scope of this standard. This document does not pertain to fall protection. This document does not apply when a performer is supported in a non-overhead suspension manner, such as lifts, elevators, turntables in stages, raked stages, treadmills in stages, or stage wagons. Systems for flying the general public or for people engaged in non-entertainment flying effects are not included in the scope of this standard."

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			event, the distinction between circus, acrobatic, theatrical, arena, and rock and roll is an artificial and irrelevant one. Should I have to apply separate different standards when doing Pippin than Peter Pan? Or Alice in Cirque-Land? What about Peter Pan performed on fabrics? Or a Peter Pan themed gala dinner in a hotel ballroom? Or Pink's next tour. Or Feld's new arena show, Ringling Meets Marvel? How would I know what design factor to use — a different one on each show, or on each act/effect within a given show? And would that mean I need to do a risk assessment on one but not the other? If I am an AHJ, I'm going to be even more confused. As it works to address input received through public comments, I suggest that the task force maintain the scope as stated, including acrobatic and circus performance, and take the time to identify the underlying principles, make appropriate allowances for differing practices and modalities, and incorporate specific provisions that directly address the needs and concerns of this segment. Of course not every provision applies the same way to every type of performance, and there are practices and protocols that are specific to different types and styles of performance. This can present challenges both to the creators and the users of the standards. For example, the standards identify particular roles and responsibilities, yet management and operational structures vary widely. Many circus and acrobatic rigging systems do not have "operators." The rigging system is completely fixed, and the performer is responsible for all movement. This does not obviate the need to have an appropriately authorized person watching what is happening at all times. I think the task group did the right thing by excluding from consideration connections to the performer relying on the performer's strength or skill. But the rest of the system, along with the means of connection of the equipment to the structure, and the techniques for doing it, are the same whether it is a strap act, a harnessed Peter Pan, a harnessed bungee performer, or a flying carpet ride. (Arguably, the "hair-hang" act in the Ringling show is in fact at its core a ride-on prop or harness-based performer flying system effect where the mechanical connection happens to attach to the performers' hair.) The physics and engineering do not change, and good basic practices are good basic practices. Specifics will vary widely and the standards need to	

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			recognize this. For example, while an important goal of most theatrical performer flying systems is to minimize the shock load or peak dynamic load on the system, it is common in the circus and acrobatic industries to see measured applied dynamic loads of between six and ten times the static load. (Current research is being undertaken by the Ecole Nationale du Cirque in Montreal to create a statistically useful database of typical dynamic loading scenarios generated on a wide range of acts and apparatus types.) The standard should allow for lots of different ways of doing lots of different things. But fundamentals are the same and we have the opportunity through this process to lock important principles into place: Think about risks and hazards methodically. Have qualified people involved in the design. Understand and apply appropriate design factors, including accounting for peak (such as shock) loads. Use rated equipment where feasible, and to use it within its rating. Test systems and components appropriately, especially where custom or non-rated equipment is being used. Limit access to people who know what they are doing. Inspect regularly and thoroughly. Have and rehearse emergency plans. Maintain good documentation. And so forth. Finally, I believe that the draft standards provide a great tool to facilitate clarity and communication between performers, riggers, venues, and presenters. Here at last is a tool enabling a rigger or, for that matter, a performer to be able to say “No” to crazy stuff, and point to something objective as backup for that position. I look forward to hearing the results of the public comment period and participating appropriately in the next phase of work. I am sorry that I will not be able to attend the Dallas meeting in July. Please feel free to contact me at any time to discuss or explore any of the issues raised herein. [end]	
59.	JH	General	Below please find my objections to BSR E1.43-201X, with proposed amended language. I am a "materially affected" person. I have rigged performers for over twenty years, and am currently developing performer-flying equipment for manufacture. I have extensive personal experience as a designer and	Reject. No specific action requested.

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			project manager of automated and manual performer flying systems. I laud the committee's effort on a difficult undertaking. The document overall is quite impressive, reflects well on the participants, and does credit to our industry. However, as detailed below, based on my experiences inside the industry the draft language: * Does not adequately apply RA/RR to lifting media as a critical component in some circumstances. * Does not adequately define the WLL applicable to lifting media on powered ("mechanized") systems. * Does not place adequate responsibility on hoist manufacturers for validating hoist/ lifting-media combinations dictated by hoist configuration. * Does not address the effect on WLL of strength loss and deformation from use of swivel attachments on Category 2 and 3 wire ropes despite unambiguous warnings from wire rope manufacturers and engineers. * Fails to acknowledge technical advances in wire rope engineering, in a manner that legitimizes widespread poor practice and creates disincentive for safety advances that industry standards should encourage. I will break these objections into two broad categories. **[SEE COMMENTS 60 AND 61]**	
60.	JH	2.40, 5.6.1.12-13	**Objection 1: Definition of WLL and application of RA/RR** Current language: *"2.40 working load limit (WLL): The maximum weight as defined by the Flying System Designer that a User is allowed to apply to a lifting medium in the*	Accept in principle. Add the following: "4.10.1.1.2 The maximum force that can be produced by the electromechanical actuator shall be evaluated as part of the process to determine peak loads in the

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			performer flying system." The draft language appears to allow a Flying System Designer(FSD) to declare a WLL lower than the hoist capacity. Under the above language the*intended* payload governs regardless of higher potential force in the system. See BSR E1.43-201x 5.6.1.12, 13. This is equivalent to giving the FSD discretion to declare a notionally-lower WLL for a 1T chainhoist without modifying the load limiter, then use weaker-than-spec chain. When this resulted in a broken chain during a foreseeable collision, the Flying Operator and Spotter would be blamed for having exceeded the designer's notional WLL. Powered hoists know only physics and take no notice of "intended" loads. Nor does the Operator have the option of dialing down the force of a hoist. ***Proposed Amended Language, 2.40, WLL: The force available to a mechanically powered performer flying system operating at maximum rated speed per the hoist manufacturer, or the maximum payload weight approved by the Designer of any other performer flying system.*** ***Proposed Added Language (5.2.1.1 or other existing section?): The hoist manufacturer shall verify that the Flying System Designer has specified flexible lifting media suitable to a WLL based on the hoist rated capacity at maximum speed, and that the hoist drum is compatible with the use of such lifting media.*** The use of "at maximum speed" as the baseline allows for the typical increase of torque at lower speeds while maintaining a reasonable margin of safety. I believe this is what the Standard already contemplates in other circumstances. **Background**: Pressure from Creative Designers creates an incentive for Flying System	performer flying system." "4.10.1.1.3 If an electromechanical actuator is selected that is capable of producing a force that would overload any of the elements in the load path based on the required design factor, then the Flying System Designer shall incorporate measures to reduce the maximum force from the actuator on the components in the load path so that the required design factors are satisfied."

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			Designers to specify smaller-diameter lifting media for aesthetics. FSDs influence the purchaser's vendor selection, creating a commercial incentive for vendors to comply with questionable requests from the FSD, including grooving winch drums for lifting media smaller than the hoist design originally contemplated. This dynamic creates a conflict of interest that affects safety-critical decisions. I have sourced lifting media under these circumstances as a project manager at a major company engaged in performer flying, and know the problem to be organizational. For a range of reasons, specifications for hoists and their lifting media can be poorly coordinated. The draft language would arguably allow 2000lb wire rope on a 2000lb hoist as a 10:1 design factor, if the Designer announced an "intent" to fly only 200lbs on a system originally planned for higher capacity. The proposed language would *disallow* the above, as an unacceptable 1:1 design factor per the hoist capacity. Clearly this is the more accurate characterization. I suggest the committee weigh the emerging repercussions of an incident in which a hoist drum was grooved for smaller-than-usual wire rope at the client's request, on the justification that the *intended* payload was less than the hoist rating. A diverter block in the same system was also under-engineered relative to the hoist output. Simultaneously, performers were at known risk of meeting a solid obstruction and occasionally did strike it. Ultimately, a performer's equipment struck an obstruction, a diverter block deflected under the applied tension of the full hoist capacity, and the lifting media failed causing a fatal injury to the performer. This accident was a textbook example of under-engineering critical components (lifting media and block) relative to non-critical components (hoist clutch or breaker). The system essentially used life-critical components as a fuse link in event of an overload. This should be unacceptable on a drumhoist as with a chainhoist. The hoist was saved from stalling at the cost	

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			of a performer's life. I discussed these issues with coworkers who built that system, several years before the accident. Their position was that the performer weight could not result in a catastrophic accident. This was true: instead, the hoist capacity provided the force for the tragedy. It was apparent to me then and now that the industry needs a firm understanding that hoist capacity should determine WLL; that critical components should be sized to stall the hoist just as they would stall a chainhoist; and that known de-rating factors of the lifting media should not be glossed over in calculating WLL relative to Minimum Breaking Strength (MBS). Under a rational RA/RR, the Standard should require performer flying systems be engineered for the hoist capacity's effect on the *weakest critical component.* The RA/RR analysis should be continued until, like a chainhoist, the worst-case outcome is a slipped clutch or a tripped breaker. *See* BSR E1.43-201x 4.2.6.3. The Designer should *not* be allowed to transfer the liability of a fundamentally flawed system to the Operator or Spotter by introducing a notional WLL below the hoist capacity. The proposed language addresses this issue and also protects project managers and automation vendors from political or commercial pressure to sign off on components undersized relative to hoist capacity.	
61.	JH	4.8.2.2	**Objection 2: Swivel Attachments, Sound Practice, and MBS.** The use of swivels on Category 2 and 3 wire ropes is almost universal, yet is contrary to published warnings by almost every wire rope manufacturer, and published information from wire rope engineers. This practice causes a strength loss of 40% according to manufacturers. As a measure of significance, this figure approaches the 50% strength loss from bending wire rope around a pin of its own diameter. The use of swivels on Category 2 wire ropes causes milking of the strands that in performer flying systems with long drops quickly becomes visible as birdcaging near the upper end of the wire	Accept in principle. Make the following changes to 4.8.2: **4.8.2 Terminations and Swivels** The lifting medium shall be able to be securely terminated at both ends. 4.8.2.1 All terminations shall be made in accordance with manufacturer's

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			rope. Before becoming visible, the entire load is transferred to the inner strands which are only 40% of the strength of the the wire rope, leaving the outer strands slightly slack. In typical resident show performer flying, this will produce a birdcage in the upper section of rope within two or three months, so the ropes are replaced on one-month cycles before the defect becomes visible. But the loss of strength is almost immediate, so the replacement cycle is a "feel-good" response. If overstressed, the core strands will fail and dump the entire load on the outer strands, which according to manufacturers will fail about about 60% of rated MBS. The Wire Rope User's Manual 4th ed., incorporated in the Standard, recognizes an issue: **"When using Category 2 or 3 Rotation Resistant Ropes, the swivel should be locked after twist is relieved to prevent uncontrolled rotation. Consult the wire rope manufacturer for guidance on any specific rope construction." (Wire Rope User's Manual, 19).** The draft standard also recognizes: **4.2.7.1.2 Selection of purchased components shall be based on evaluation of component manufacturer's technical data and written guidelines.** Before about 2007, the practice of free-spinning swivels on Category 2 wire rope might have been justified on grounds that no non-rotating wire rope existed in the smaller sizes needed for performer flying. But that is no longer true, and the committee has an obligation to push the industry forward rather than endorse stagnation: "The goal of the Program is to take a leading role regarding technology within the entertainment industry by creating recommended practices and standards." (BPR E1.43-201x, ii). "Revisions result from committee consideration of factors such as technology advances." (BPR E1.43-201x, vii).	specifications. De-rated values of the lifting media due to terminations shall be considered in determining design factors and related strength data. 4.8.2.2 ~~De-rated values of lifting medium due to terminations shall be used when determining design factors and related strength data~~. The use of swivels shall be in accordance with the rope manufacturer's recommendations and de-rated values of the lifting media due to the use of swivels shall be considered when determining design factors and related strength data. (See Annex note.) Add the following Annex note: **A4.8.2.2 Swivels.** It is advisable to use a rotation-resistant rope that will rotate minimally when loaded, in order to mitigate the hazard of the rope causing rotation of flying performer suspended from a flexible lifting medium and to ensure the safety of personnel beneath the flying area. The swivel helps relieve the any induced rotation on the rotation-resistant rope resulting from angular deflections at a sheave or drum. Other rotation-resistant ropes that have less resistance to rotation when loaded, will likely need a swivel to help minimize the likelihood that the flying performer will rotate. The Flying System Designer should be aware that excessive rope rotation can compromise rope performance and can also cause a reduction in ultimate breaking strength of the rope. This reduction will

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			Seven years have passed since a manufacturer (WireCo World Group) adapted extant technology to offer the entertainment industry a non-rotating wire rope specifically designed for high-speed human lifts with swivels. This rope (XLT4, 4x31) is nearly 100% efficient with swivels, and its MBS is far higher than any other wire rope of equal size. The manufacturer provides written support for performer flying applications, at a D:d of 20. It has been extensively used by certain Cirque Du Soleil shows and demonstrated superior performance and far better durability than Category 2 and 3 wire ropes. National Telephone also invested time and money in developing a higher-strength sleeve to take full advantage of the new wire rope's MBS with standard hand crimping tools. Since 2007 the performer flying industry has pushed technology forward in every single area except wire rope. This is a striking omission, because lifting media is the embodiment of the "single point failure" that BSR E1.43-201x says must be mitigated. *The effect is that a major safety advance is penalized by the draft language, which ambiguously leaves lifting media that fails to meet the across-the-document intent of the Standard on an equal footing with a safer product that meets every aspect of the standard in letter and spirit, but for which the manufacturer must inevitably charge a slightly higher price.* Consider the following: 19x7 1/4" 5400lbs, net with swivel 3240lbs, deforms, warned against, and D/d 34 4x31 1/4" 8500lbs, net with swivel 8500lbs, stable, recommended, and D/d 20 The use of 3240lb net-strength wire rope falsely calculated at 5400lbs for WLL purposes undermines the legitimacy of design factors; its use contrary to manufacturer warning is also contrary to the intent of the Standard; and its invariable use on undersize sheaves is also contrary to the intent and	depend on the characteristic load and the rotational properties of the selected rope. The selection of the rope and swivel for the intended performer flying routine and loads should be should be assessed by a qualified person, who should determine the criterion and intervals for examining the rotating rope and swivel hardware.

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			probably the letter of the Standard. Mr. Sapsis (Bill) has told me that the Standard will not address the misuse of swivels on Category 2 and 3 wire ropes for fear of appearing to grant a monopoly to what might be the only good alternative. This concern is misplaced: compliance with the Standard is "entirely within [the] control and discretion" of the manufacturer or provider, so there can be no risk of monopoly. (BSR E1.43-201x, i). People buy what they want, but the Standard should encourage innovation rather than penalize it by legitimizing products that do not meet spec, and turning a blind eye to false calculations and poor practice, which is the state of the industry today. The playing field is tilted against the manufacturer who has invested in innovation and improved safety, only to be undersold by the manufacturer who has not. More importantly, no other manufacturer will invest in competitive swivel-compatible wire rope if the situation remains this way. This is against public interest and PLASA by policy should move the industry forward rather than codifying stasis. The committee has numerous alternatives to encourage use of swivel-compatible wire ropes for performer flying without granting anybody a "monopoly". Consider these alternatives: **Proposed Amended Language (4.8.2.2): De-rated values of lifting media due to terminations or swivel attachments shall be used when determining design factors and related data.** The above is simply honest math, nothing more or less. *This is something the committee should do at a minimum.* **Proposed Added Language: The use of free-spinning swivel attachments should be limited to Category 1 or equivalent wire ropes. Where the performer flying system uses Category 2 or 3 wire rope as lifting media, the Flying System Designer takes full responsibility for**	

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			the use of swivels. **Proposed Added Language, Fatigue Factors 4.8.5.6: The use of swivel attachments that allow Category 2 and 3 wire ropes to rotate freely, placing disproportionate tension on the core strands and causing internal wear at the crossover points of the inner and outer strands, shall be considered when selecting wire rope for performer flying systems.** To put it bluntly, the industry is complacent and needs pushing. Termination hardware only 60% efficient would be scorned and unmarketable. An accessory that reduced the strength of adjacent carabiners by 40% would be assailed as hazardous. Better wire rope has been available for seven years, but nobody uses it because nobody else uses it. We have compromised on wire rope for so long, we except it from sound practice. I ask the committee to tell the industry what is unquestionably true: we can do better.	
62.	CDS	7.6	Due to the longevity of our resident productions, and the permanent style of the system installations, we propose the following as alternative to section 7.6 **7.6 In-service testing** Periodic testing shall be performed to validate the continued safety of the system. **7.6.1** Such testing procedures shall be determined by the Flying Ststem Designer, System Supplier and User based on a RA/RR. **7.6.2** Testing intervals shall be determined by the Flying System Designer, System Supplier and User based on a RA/RR. The Flying Safety Supervisor shall designate or hire a tester, and shall supervise such testing. **7.6.3** The flying equipment shall not be used if deficiencies of concerns regarding the safe use of the system arise as a result of the testing. The performer flying system may be used only after the concerns or deficiencies	Accept in principle. Reviewer proposes no changes to 7.6.1 and 7.6.3. Change to: "**7.6 In-service testing** Periodic ~~and daily~~ testing shall be performed to validate the continued safety of the system." **"7.6.2** The performer flying system is to be load tested <u>at predetermined testing intervals</u>, ~~daily, preferably before each use~~ using the anticipated amount of load to be flown, regardless of whether it is being used for rehearsals or performances. <u>Testing intervals shall be determined by the</u>

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			are corrected and a test has been conducted resulting in positive results.	Flying System Designer, System Supplier and User based on a RA/RR. The Flying Safety Supervisor shall designate or hire a tester, and shall supervise such testing.**"**
63.	CDS	4.5.2	There is no discernible difference in the draft document between a 'ride-on prop' and an apparatus designed for acrobatic use; so for section 4.5.2 we propose this alternative, that references back to the scope section at the start of the document for 'strength and ability of the Flying Performers'. **4.5.2 Ride-on props** **4.5.2.1** Any flying vessels, platforms, or props shall be designed by a qualified person. **4.5.2.2**Ride-on props shall be designed to comply with 4.3.3 Loading conditions. **4.5.2.3** Ride-on props shall be attached in a manner that in the event of a failure of the prop support lines the prop does not become supported by the Flying Performer, the Flying Performer's harness, or any point along the load path the thee Flying Performer. **4.5.2.4** All Flying Performers riding on or in flying vessels, platforms, or props shall be tethered directly to the load path, unless a RA/RR does not require them to be tethered, such as in the case of acrobats on an acrobatic apparatus that relies on the strength or ability of the Flying Performer(s).	Reject. Connections that ultimately rely on the strength or ability of the flying performer are outside of the scope of this document.
64.	CDS	4.2.6.5.2	The following suggestion, allows the use of 'safe' electronic or mechanical device to guarantee that an impact with an end stop cannot happen at full speed. **4.2.6.5.2** The end stops shall be designed to take a full speed full load impact without causing catastrophic mechanical or structural failures that would result in an unsafe condition, unless a 'safe' slow zone mechanism is implemented that precludes the ability for the travelling component to impact the end stop at full speed and/or full load.'	Accept. This subject is now covered in Section 4.2.7.1.2. Change to: "**4.2.7.1.2** The end stops shall be designed to take a full speed full load impact without causing catastrophic mechanical or structural failures that would result in an unsafe condition, unless a 'safe' slow zone mechanism is implemented that precludes the ability for the travelling component to impact the end stop at full speed and/or full load.
65.	CDS	2.7	The following suggested replacement section clarifies that even if motion does not stop, then power is eventually removed to leave the machine in a safe, known state. **2.8 Category 1 stop:** A controlled stop with power to the machine actuators	Accept. Change to: "**Category 1 stop:** A controlled stop with power to the machine actuators available to achieve the stop, then removed when the stop is achieved,

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			available to achieve the stop, then removed when the stop is achieved, or after a timeout occurs.	or after a timeout occurs."
66.	RP	General	General Comments Add ***** to all item numbers that are referenced in the appendix. The forward says this will be done and it hasn't been in all cases. **A4.2.3 Physical Testing** has no ***** at section **4.2.3** which is also not titled "Physical Testing". **A4.2.5.5.1** appears to belong to section **4.2.6.5.2** in the document. **4.10.2.3.1 Limits*** has nothing relating to it in the Appendix. The (*) placement is inconsistent. Sometimes it immediately follows a section heading, and sometimes it appears after a space. Sometimes it appears at immediately after the last word in the section and sometimes there is a space.If all the *****s were place immediately after the section numbers, it would be easier to check them for accuracy.	Accept in principle. All annex sections will be referenced to sections. Asterisk will be replaced with "(See Annex note.)"
67.	RP	General	Replace "must" with "shall" in the body of the document. See 3.15, 4.6.4, 4.7.2, 4.8.1.3, 4.10.1.2.6, 4.10.1.2.8, 4.13.3, 4.13.3.3, 4.13.4.1, 4.13.4.2, 4.13.5.1, 7.8.2.1, 7.8.5.1, 7.8.7.1, 7.9.3.1, 9.2.2	Accept.
68.	RP	General	There are many occurrences of "must" in the appendix. In **A.4.3.3.2.3** alone there are 7 occurrences. If it is mandatory, the item should be moved to the body of the document, if they are not mandatory, replace "must" with "should".	Accept in principle.
69.	RP	General	Change ":" after defined words to ";".	Reject. Format is consistent with E1.6-1-2012.
70.	RP	General	Review document for style inconsistencies and compliance with style guidelines.	Accept. Style review will be conducted prior to final issuance of document.
71.	RP	2.25	2.25 fly or flying system A system of mechanical components used to lift a performer incorporating any combination of manual, mechanical, electric,… Comment: Eliminate first occurrence of the word "mechanical". Also could a manual component be mechanical? Would pneumatic or hydraulic components not comply with the standard? Suggest: A system of components used to lift, control the flight, and land a performer. The system structural components include all components from the structural attachment through and including the harness or other performer supporting device. In addition the system includes all components	Accept in principle. Change to: "A system of ~~mechanical~~ components specifically designed to transport a performer through the air ~~lift a performer incorporating any combination of manual, mechanical, electric, electronic, and/or electromechanical devices~~. The performer flying system includes the attachment to the facility/structural support down to and including the harness or other device that

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			that control the speed, direction, rotation, acceleration, deceleration and stopping.	provides direct support for the performer."
72.	RP	2.30	2.30 Rescue System The operational procedures and associated equipment used to perform a rescue. Comment: Why are procedures a part of a rescue system and not part of a flying system? Suggest: A system of components used to land a flown performer in a safe location in case of a flying system malfunction or a medical emergency.	Accept. Change definition to: "rescue system: A system of components used to land a flown performer in a safe location in case of a flying system malfunction or a medical emergency." Add the following definition: "rescue plan: The operational procedures used to perform a rescue."
73.	RP	3.10	3.10 Incident Commander Competent person in charge during an emergency or rescue situation. Comment: In charge of who and what? This section is titled Responsibilities. More attention should be given to assigning specific responsibilities to this and other team members. Is the incident commander in charge of the first responders like the paramedics and the fire department? There is much detail listed for Spotter's responsibilities. Though the skills of the Incident Commander and Rescue Riggers are less often to be used, it is equally important that they be quantified.	Accept in principle. Change to: "Competent person responsible for directing emergency crew and rescue operations during an emergency or rescue situation."
74.	RP	3.13	3.13 Rescue Rigger Competent person who is responsible for performing rescue operations. Comment: One of the rescue riggers main responsibilities is to understand and complete the rescue in accordance with existing rescue standards. Suggest: Competent person who is responsible for performing rescue operations under the direction of the Incident Commander in accordance with ANSI Z359.4 Safety Requirements for Assisted Rescue and Self-Rescue Systems and Components.	Accept in principle. Requirements for rescue rigger procedures are not included in the definition of the responsibility; nevertheless, "competent" is replaced with "qualified." Change to: "Qualified person who is responsible for understanding the rescue plan and performing rescue operations under the direction of the Incident Commander."
75.	RP	3.17	3.17 System Supplier Comment: According to the existing responsibilities, unless the Fly System Designer specifically requires it, the supplier is not responsible for inspecting the system for defects prior to delivery. Shouldn't that at least be one of their responsibilities?	Reject. Requirements for inspection are not included in the definition of the responsibility. See Sections 5.5 and 5.6 for relevant inspection and testing requirements.
76.	RP	4.2.7.1.3	4.2.7.1.3 Purchased components selected shall be supplied with a visible	Accept in principle. This subject is now

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			load rating mark or certification of its load rating or strength. Comment: Rated load and strength are two entirely different concepts and should not be combined in this fashion. A load rating cannot be derived from a strength alone. Many other factors such as toughness, ductility, and fatigue resistance need to be evaluated along with the application. This can only be done by a qualified person, especially in a critical lift situation such as overhead lifting or flying performers. If an item is not designed as a lifting product with a published rated load, then Section 4.2.6.1.4 should apply. Suggest: Purchased components selected shall be supplied with a visible load rating mark or certification of its load rating by the manufacturer.	covered by Section 4.2.9.1.3. Change to: "Purchased components selected shall be supplied with a visible load rating mark <u>from the manufacturer</u> or certification of its load rating <u>by the manufacturer, unless components meet the specifications of 4.2.9.1.4.</u>"
77.	RP	4.6.4	4.6.4 Purchased hardware used for quick-connect hardware must bear a load rating that is permanently marked on the hardware. Comment: This requirement would eliminate the use of carabiners as quick-connect hardware. There is no rated load marked on them, nor is there load ratings published by the manufacturers. To allow certain carabiners to be used for single performers, they should be individually proof tested to 16kN , and allowed to be used with the same restrictions as noted in ANSI Z359.1 or ANSI Z359.4. This requirement would also eliminate the use of locking alloy hooks that are rated for overhead lifting, arguably the least likely to fail type of quick-connect hardware available. They are also single action locks, but by virtue of their construction, are no weaker even if somehow the gate opened, which would be virtually impossible.	Reject. Carabineers and other hardware without permanently marked load rating shall not be used for flying performers.
78.	RP	4.13	4.13 Rescue Comment: First, there is already an ANSI Standard for the safety requirements for rescue. It should be referenced and adhered to when and wherever possible. There are many requirements for motorized and manual lifting devices used in rescue operations. It is possible and perhaps probable that many flying systems do not meet the requirements of the standard and therefore should not be used as rescue devices. Rescue is not defined in the document, but from reading the document it could be required for; (a) a loss of power that disables the flying system, (b) a mechanical failure of the flying system, (c) a medical emergency, or (d) environmental reasons that would require an immediate landing of the performers. Only cases (a) and (b) would a rescue system be required. In the case of (c) and (d) the flying system could be used to land the performer(s). To avoid including the flying system as a part of the rescue system it seems like a separate section from the Rescue section should be added called "Emergency Landing" to	Accept in principle. With regard to referencing a specific standard, the variables associated with performer flying rescue precludes a mandate of a specific rescue standard. We agree that these and other applicable standards should be referenced in the development of a rescue plan. The following revision will be made: "**4.13.1 Design responsibility** The rescue system shall be designed by a qualified person. <u>The rescue plan shall</u>

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			accommodate those instances when a modification to the flying system or plan could rapidly land the performer. A "rescue" would only be required when the performer is stuck in the air. Comment: As an Appendix note, a statement should be made that where feasible, the performer should be attached to a fall protection system for their safety prior to being disconnected from the flying system during the rescue operation. As a good recue practice, many rescue system designs include fall protection systems for the fallen worker that will keep them connected to two systems at all times during the rescue. Along a similar line, SPRAT and IRATA rope access workers are required to be connected to two separate systems at all times as well.	include references to applicable reference standards employed in the rescue plan, based on the equipment and techniques used. Custom fabricated components shall conform to Section 4.2.10 Fabricated Components." The following will be added clarifying that emergency landing is the commonly primary rescue technique: **"A4.13.3 Primary Rescue** Primary rescue is typically done by performing an emergency landing using the flying system." With regard to use of fall protection prior to attachment to the flying rig, this is implied by the general statement added to Section 7.8 **Training**: "All people directly or indirectly involved in the performer flying effects shall be appropriately informed and trained regarding the dangers, hazards, safety measures, operational requirements and procedures, rescue procedures, and responsibilities of the various participants involved in the use of the performer flying system. Training shall include safe access to and egress from all locations where a flying performer connects to the flying system. Personnel directly involved in the use of the performer flying system…" The following will be added to the Annex: "**A.4.13.9.1** There are a number of

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				nationally recognized standards for the potential equipment used for rescue systems. Rope access rescue equipment and techniques are becoming more common. The following is suggested reading for rope access rescue: "Safe Practices for Rope Access Work," published by Society of Professional Rope Access Technicians (SPRAT), USA, 2012. (http://www.sprat.org/resources/Safe_Practices%20-%20August%202012.pdf) "Certification Requirements For Rope Access Work, Version 13," published by Society of Professional Rope Access Technicians (SPRAT), USA, 2013. (http://www.sprat.org/resources/SPRAT_Certification_Requirements_WebVersion.pdf) "Technical Rescuer: Rope Levels I and II" by Jeff Mathews, Published by Delmar - Cengage Learning, USA, 2009. "CMC Rescue Rope Manual, Revised 4th Edition," Edited by James A. Frank, published by CMC Rescue, Inc. "Rope Rescue for Firefighting" by Ken Brennan, Published by PennWell Publishing, USA, 1998. "The Essential Technical Rescue Field Operations Guide, Edition 4," by Tom Pendley, Published by Desert Rescue Research, USA, 2010."
79.	RP	4.13.1	4.13.1 Design Responsibility The rescue system shall be designed by a	Reject. The variables associated with

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			qualified person. Custom fabricated components shall conform to Section 4.2.6.2 Fabricated Components. Comment: There is an ANSI standard that specifically deals with rescue systems and rescue system components, including design and testing requirements. Rescue systems should be designed to that standard at a minimum. If a rescue is required for more than the equivalent of two people, then a more robust system would be required. Suggest: The rescue system(s) shall be designed by a qualified person to meet the requirements of ANSI Z359.4 unless the rescue load is greater than 620 lb. In that case all system components shall meet the requirements of Section 4.6.2 of this standard.	performer flying rescue precludes a mandate of a specific rescue standard. We agree that these and other applicable standards should be referenced in the development of a rescue plan. The following revision will be made: "**4.13.1 Design responsibility** The rescue system shall be designed by a qualified person. The rescue plan shall include references to applicable reference standards employed in the rescue plan, based on the equipment and techniques used. Custom fabricated components shall conform to Section 4.2.10 Fabricated Components."
80.	RP	4.13.2	4.13.2 Rescue systems The rescue systems collectively shall guarantee safe rescue of the flying performers under all conditions including emergencies and loss of power. There… Comment: This seems like an unachievable requirement. Systems can't guarantee, and performing under "all conditions" is impossible. Conceivable conditions like a conflagration or an earthquake or a structure failure would be impossible design considerations. Suggest: The rescue systems collectively shall accommodate safe rescue along the entire flight path and shall remain functional during the loss of power.	Accept. Change to: "The rescue systems collectively shall ~~guarantee~~ accommodate safe rescue ~~of the Flying Performer under all conditions,~~ along the entire flight path and shall remain functional during the loss of power. There may be multiple rescue…"
81.	RP	4.13.2.1	4.13.2.1 Primary rescue … The primary rescue system shall be the safest and most expeditious method of rescue. Comment: This is a requirement that most likely cannot be met. "Safest" and "most expedious" cry out for something to be compared to. Replace the last sentence with: The primary rescue system shall be designed with the safety of the performer, audience, and rescuers along with expediency as primary design parameters.	Accept. This subject is now covered by Section 4.13.3. Change to: "A primary rescue system is required. The primary rescue system shall be the first rescue method utilized unless there are situational restrictions to using the primary rescue system. The primary rescue system shall be ~~the safest and most expeditious method of rescue~~ designed with the safety of the performer, audience,

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				and rescuers along with expediency as primary design parameters." The following is added to the Annex: "**A4.13.3 Primary Rescue** Primary rescue is typically done by performing an emergency landing using the flying system."
82.	RP	4.13.2.2	4.13.2.2 Secondary and subsequent rescue Secondary and subsequent rescue systems are required unless the primary rescue system is guaranteed under all conditions, including emergencies and loss of power. … Comment: Who could possibly guarantee this? Suggest: Secondary and subsequent rescue systems are required. …	Accept. This subject is now covered by Section 4.13.4. Change to: "Secondary and subsequent rescue systems are required ~~unless the primary rescue system is guaranteed under all conditions, including emergency and loss of power~~. Secondary and any subsequent rescue systems shall be employed when situations arise that do not allow the safe use of the primary rescue system."
83.	RP	4.13.3	4.13.3 Rescue plan design considerations The rescue plan must… Suggest: The rescue plan shall…	Accept. This subject is now covered by Section 4.13.5. Change to: "The rescue plan shall allow a safe rescue to be performed throughout the flight path."
84.	RP	4.13.3.1	4.13.3.1 Comment: Impossible requirement. Syncopy can occur within a short period of time, and arterial rupture could cause death in a few minutes, not to mention heart attack, stroke etc. Realistically a rescue could take at least 10 minutes to get the performer to a safe place, and in many cases it would take much longer. Personally I would be ecstatic to see 10 minute rescues.	Accept in principle. This subject is now covered by Section 4.13.5.1. Change to: "In order to mitigate the risks of restricted blood circulation and other health problems, the rescue plan shall include provisions to transport the Flying Performer to a safe location and shall minimize the time needed to perform the rescue for all reasonable foreseeable situations that can occur, including system failure, unconscious Flying Performer, and loss of power."

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85.	RP	4.13.3.4	4.13.3.4 Comment: I think this should be moved out of the rescue section and into a new section called "Emergency Landing". See my comment under 4.11. In an emergency situation, the first question to be answered in the decision tree should be, "Can the flying System be safely used for an emergency landing?" If the answer is yes, a rescue is not necessary.	Reject. This subject is now covered by Section 4.13.5.4. The definition of rescue is as follows: '*The prompt return of the Flying Performer to a safe location and disconnecting from the performer flying system in the event of Flying Performer's danger or distress*.' This includes an emergency landing. The following is added to the Annex: "**A4.13.3 Primary Rescue** Primary rescue is typically done by performing an emergency landing using the flying system."
86.	RP	4.13.5.1	4.13.5.1 The rescue system may include elements used for fall protection, building maintenance and inspection access, ladders, moveable stairs, personnel lifts, recreational climbing equipment, flying machinery, and/or rigging hardware. All such equipment must meet applicable, nationally recognized industry standards. Comment: The rescue system should be mainly comprised of rescue equipment. All equipment used to support the performer being rescued, if attached above the worker to lower or raise the worker should be rescue equipment and meet all the requirements for the application as listed in ANSI Z359.4. In no case does recreational climbing equipment meet these standards. It is not manufactured with the intent to be used for anything in industry. A few recreational climbing hardware companies have gone out of business because people have decided to use this type of recreational equipment in industry. There have been a few lawsuits over the years because of the use of recreational climbing equipment in our industry alone. Most recreational manufacturers are not insured for the risks associated with industrial use. Suggest: Rescue system elements used to raise or lower the performer from above shall meet ANSI Z359.4 requirements for the application. System components used to raise or lower the performer from below shall be used in a fashion that meets the applicable ladder or lift standard. If flying machinery is used as a part of a rescue, the Fly System Designer or other qualified person shall make the determination prior to its use as a rescue component that the machinery would meet all requirements as specified in ANSI Z359.4.	Accept in principle. This subject is now covered by Section 4.13.9.1. Change to: "The rescue system may include elements used for fall protection, <u>assist-rescue and self-rescue systems, rope access systems</u>, building maintenance and inspection access, ladders, movable stairs, personnel lifts, ~~recreational climbing equipment,~~ flying machinery, and/or rigging hardware. All such equipment must meet applicable, nationally recognized industry standards."

Approved resolutions to comments received during the first public review of BSR E1.43

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87.	RP	4.13.5.2	4.13.5.2 If fall protection equipment is used as part of a rescue system, it shall comply with requirements of OSHA 1926 Subpart M. Comment: If used as a rescue component it should meet the requirements of ANSI A359.4, if as a fall protection component, Z359.1. Suggest: If during a rescue, fall protection equipment is used as a fall protection component, it shall meet the requirements of ANSI Z359.1. If it is used as a rescue component, it shall meet the requirements of ANSI Z359.4.	Accept. This subject is now covered by Section 4.13.9.2. Change to: "If during a rescue, fall protection equipment is used as a fall protection component, it shall meet the requirements of ANSI Z359.1. If it is used as a rescue component, it shall meet the requirements of ANSI Z359.4."
88.	RP	7.5	7.5 In-service inspections Comment: There is no mention of the requirements for inspection of rescue equipment. The general requirement is that it be inspected prior to each use as with fall protection equipment. In a practical sense, this means daily, since time is of the essence when a rescue is required. A section should be added that fall protection and rescue equipment should be inspected daily, prior to use, in accordance with ANSI Z359.1 and Z359.4 respectively.	Accept in principle. This subject is now covered by Section 7.6.4. Add clause: "7.6.4 The rescue equipment shall be visually inspected periodically, in accordance with ANSI Z359.1 and Z359.4 respectively, regardless of whether it is being used for rehearsals or performances. The Flying Safety Supervisor shall designate an inspector, and shall supervise such inspections."
89.	RP	Annex A.	Appendix A. Commentary Comment: Contrary to the statement in the second paragraph there are many mandatory statements in the appendix. A careful review should be done by the authors to either move the mandatory statements to the body of the standard or rethink the mandatory nature of the statements and remove the mandatory language.	Accept in principle.
90.	RP	A.4	A.4 Design and Engineering Suggest: There is no advisory statement here. Remove from appendix.	Accept.
91.	RP	A4.2.3	A4.2.3 Physical Testing Comment: There is no title associated with **4.2.3** in the document. Is **A4.2.3** actually supposed to be associated with **4.2.4.1**? Suggest: Remove "Physical Testing" Comment: The first sentence is a mandatory statement. Suggest: Move it to the body of the document and change must to shall.	Accept in principle. This subject is now covered by Section 4.2.4.1. Change to: "A4.2.4.1 When physical testing is used to determine the strength of a component or assembly, this section states that such testing shall be performed in accordance with a recognized national standard. Examples include, but are not limited to the following:…"

Approved resolutions to comments received during the first public review of BSR E1.43

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92.	RP	A4.2.5.5.1	A4.2.5.5.1 … The system must not be used… Move to body of document and change must to shall.	Reject. This subject is now covered by Section 4.2.7.2. Change to: "A4.2.7.2 Sacrificial **d**amage to readily replaceable end stop elements not relied upon for structural support is acceptable. The system shall not be used until damaged elements are replaced."
93.	RP	A4.3.3.2.3	A4.3.3.2.3 Comment: There are many mandatory statements in this section, approximately 7. Suggest: start this section over and rethink the use of mandatory statements or move them to the body, using shall instead of must.	Accept.
94.	RP	A4.5.1.2.1	A4.5.1.2.1 Comment: Remove mandatory statement.	Accept. Change to "A**4.5.1.2.1** Flying Performers should not be suspended in the harness for long periods of time in order to avoid risks to health associated with suspension trauma.."
95.	RP	A4.8.4.2	A4.8.4.2 Comment: Remove indent and Bold the type.	Accept grammatical change.
96.	RP	A4.8.5	Comment: Add "**Fatigue Factors**" after Section number.	Accept.
97.	RP	A4.13.3	**A4.13.3 Rescue Plan Design Considerations** Comment: Remove indent. Comment: Consider not calling an incident a "rescue" if the flying system is used for an unplanned landing.	Reject. The definition of rescue includes using the flying system to land the flying performer.
98.	RP	A6.4	**A6.4**, **A7.6**, **A7.9.4** Comment: Remove the indent.	Accept grammatical changes.
99.	BR	1	Scope does not state LIVE performer flying Current Phrasing: "This document establishes a minimum level of performance parameters for the design, manufacture, use, and maintenance of performer flying systems used in the production of entertainment events." Proposed Change Remove the word live • **"Entertainment Technology— Performer Flying Systems"**	Accept. Change to: "**Entertainment Technology— Performer Flying Systems"**
100.	BR	1	Scope	Accept in principle. Change to "The

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			• Use of the term Ensure in the first paragraph last sentence. • Used twice • Current Phrasing "The purpose of this guidance is to ensure the adequate strength, reliability, and safety of these systems to ensure safety of the performer under all circumstances." • Proposed change • Rephrasing to remove one use of ensure. "The purpose of this guidance is to ensure the adequate strength, reliability, and safety of these systems **and safety for the performer under all circumstances."**	purpose of this guidance is to ~~ensure~~ achieve adequate strength, reliability, and safety of these systems to ensure safety of the performer under all circumstances."
101.	BR	2.18	Definitions • 2.18 limit, normal • Word usage Current Phrasing "2.18 limit, normal: The normal (end of travel, initial, hard) limit switch prevents further movement in the direction of travel." Proposed Change "2.18 limit, normal: The normal (end of travel, initial, hard) limit switch **that** prevents further movement in the direction of travel."	Accept. Change to: "The normal (end of travel, initial, hard) limit switch that prevents further movement in the direction of travel."
102.	BR	2.19	2.19 limit, ultimate • Word usage Current Phrasing "2.19 limit, ultimate: The ultimate (overtravel, Estop) limit switch senses over-travel in the event of failure of the normal position limit." Proposed Change "2.19 limit, ultimate: The ultimate (overtravel, Estop) limit switch **that** senses over-travel in the event of failure of the normal position limit.	Accept. Change to: "The ultimate (overtravel, E-stop) limit switch that senses over-travel in the event of failure of the normal position limit."
103.	BR	3.2	3.2 Creative Designer • This phrasing says nothing about the safety of the performer or crew. The Creative Designer should be qualified enough to choreograph a flying sequence(s) without anyone getting injured. Current Phrasing "Person who choreographs the flying performance sequences and related visual conception. This person is not responsible for the technical aspects of flying."	Accept in principle. The defined responsibilities are intended to identify roles played by various possible participants. A Director or Writer may serve as the Creative Designer for the flying routine as part of the overall show enactment or choreography. This role is listed in the document in order to clarify the

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			Proposed Change **"A qualified person who choreographs the flying performance sequence(s) and related visual conception. This person is responsible for designing a safe performance for the performer(s) and crew. This person is not responsible for the technical aspects of flying"**	separate responsibility of the Flying System Designer and Flying Safety Supervisor to ensure the safety of the flying routine. Safety is ensured by either having one person serve in multiple roles (with the requirement that he/she is suitably qualified), or by the Creative Designer engaging other people to serve in the other roles. In addition, the Creative Designer is required to coordinate choreography with others. In order to improve the clarity and scope of the definitions, the following is changed: "3.2 Creative Designer: Person who choreographs the flying performance sequences and related visual conception. This person is not responsible for the design of the performer flying system ~~technical aspects of flying~~. This person shall coordinate the choreography with the Flying Safety Supervisor and overall show technical director to ensure safe operation for all involved persons." "3.8 Flying Safety Supervisor: Qualified person responsible for overall safety of the performer flying system, including training, maintenance, inspections, testing, queuing, choreography and confirming suitability of Flying Performers for intended flight."
104.	BR	4.3.3.2.7	4.3.3.2 Dynamic • 4.3.3.2.7 • Spelling error Current Phrasing • "4.3.3.2.7 lying System Designer shall evaluate effects of peak load tension on cable track line attachments points."	Accept grammatical change.

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			Proposed Change • "4.3.3.2.7 **Flying** System Designer shall evaluate effects of peak load tension on cable track line attachments points."	
105.	BR	General	Other Comments: Its unclear that which terms are defined in the document. I propose that they be italicized in the body of the document or in someway noticeable that its is a defined term.	Reject. Plasa standards do not identify in the text words that are included in the definitions.
106.	DFE	Title	This document should be retitled "Motorized Performer Flying Systems" because that is what is covers.	Reject. The document specifically refers to manual flying systems as follows: **4.2.5** Manual performer flying systems shall be designed to incorporate all of the requirements of this standard, with the exception of: 4.10 *Electromechanical actuation*.
107.	DFE	1	Scope - This document does not really address manual performer flying systems and many of the recommendations are either not applicable or run counter to what one would find in many, if not most, manual performer flying systems. For example, mechanical advantage, mechanical disadvantage, compensators, and counterweight, all of which are used in most manually operated tracked and straight-lift performer flying systems are not discussed in this document.	Reject. This document does not address specific flying system designs and is written in such a way to be as general as possible.
108.	DFE	General	Compound drums are not discussed in this document.	Reject. This document does not address specific flying system designs.
109.	DFE	General	Throughout this document the term "full speed" is used. This term could be very confusing when applied to manual flying systems.	Accept. Add the following definition: "2.17 Full speed: The maximum designed operating speed of a flying system. Add Annex note: "2.17 For manual flying systems, full speed includes speeds achieved by mechanical advantage and increases in maximum acceleration and velocity achieved via change in operator position (jumping off of a ladder). For automated systems, full

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				speed is typically the maximum speed of the hoist or winch as determined by the flying system designer."
110.	DFE	1	It has been suggested by some individuals that this document might be applied to circus/aerial dance rigging where performers are suspended or lifted. In fact, this document does not address these aspects of performer flying and the scope should exclude them.	Accept in principle. This document covers all performer flying, except for specific situations noted in the document. In order to clarify, the scope section has been modified as follows, noting that several sentences have been repositioned but not changed: 2nd paragraph: "Performer flying systems within the scope of this standard include devices and systems supporting people or components to which people are attached, suspended in the air that give the impression of weightlessness, floating, flying, or descending~~, and for acrobatic and circus performance acts~~. Situations covered by this standard pertain to any and all locations of the flight path, including over the stage or audience." 3rd to 5th paragraphs: "This document covers the machinery, mechanisms, and mechanical attachments used to support flying persons or ride-on flown props, <u>including attachment to the facility/structural support down to and including the harness or other device that provides direct support for the performer</u>, but excludes any connection that <u>ultimately</u> relies on the strength or ability of the Flying Performer. The use of bungee cord or other elastic lifting medium in the direct load path is outside the scope of this standard. This document does not pertain to fall

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				protection. This document does not apply when a performer is supported in a non-overhead suspension manner, such as lifts, elevators, turntables in stages, raked stages, treadmills in stages, or stage wagons. Systems for flying the general public or for people engaged in non-entertainment flying effects are not included in the scope of this standard."
111.	DFE	2	Definations – Common terms used in this industry, such as "fly wire" and "flying director" are not defined or discussed in this document.	Accept in principle. These common terms will be noted in the Annex as follows: "A2.19 When Lifting Medium is a wire rope, it sometimes called a fly wire." "A3.9 Flying Supervisor is sometimes called Flying Director."
112.	DFE	2.11 **[4.2.6.7]**	D:d ratio is defined in 2.11, but I did not find it used in the document. There is no need to define terms that you do not use.	Reject. Section 4.2.7.3 uses D/d ratio. The definition will change to: "D:d" to "D/d."
113.	DFE	4.8.4.1	4.8.4.1 - Minimum design factor of WLL should be no greater than 8. Also, this section does not find any distinction between Dfs for cables that pass over pulleys and those that do not. This should be addressed. Cables that do not pass over pulleys should have a min. DF of 4.	Reject. ANSI E1.6-1 specifies a minimum design factor of 8X WLL for machinery not supporting flying performers. As a baseline for safety a higher minimum design factor (10X WLL) for flying people is warranted. Section 4.8.6 allows a reduced minimum design factor of not less than 5X WLL for in-view flexible lifting media and Section 4.1 allows for variation in these guidelines assuming pursuant to proper analysis.
114.	SCI	General	I strongly object to the inclusion of circus and acrobatics rigging in this standard. The terms "circus" and "acrobatic" appear exactly once each in the proposed standard, and that is in the scope. This standard is very specific to track and wire based theatrical performer flying. While these systems can be used in the circus (and application of this standard in those cases is not objectionable to me), this standard is likely to cause a lot of confusion within the industry as people attempt to apply this to circus and acrobatic rigging. I recommend the terms "circus" and "acrobatic"	Reject: Exclusions are clearly stated. Also, see Response to Reviewer SCI, Section 1.

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			be removed from this standard. If these terms are retained, then this standard needs to be completely reworked to include circus and acrobatic rigging.	
115.	SCI	1	In section 1, I strongly object to the inclusion of "and for acrobatic and circus performance acts". This standard clearly does not apply to these systems, and its inclusion is likely to cause considerable harm to that industry.	Reject. This document covers all performer flying, except for specific situations noted in the document. In order to clarify, the scope section has been modified as follows: 2nd paragraph to read: “Performer flying systems within the scope of this standard include devices and systems supporting people or components to which people are attached, flying or suspended in the air, including acrobatic aerial acts. Situations covered by this standard pertain to any and all locations of the flight path, including over the stage or audience.” 3rd to 5th paragraphs: “This document covers the machinery, mechanisms, and mechanical attachments used to support flying persons or ride-on flown props, including attachment to the facility/structural support down to and including the harness or other device that provides direct support for the performer, but excludes any connection that ultimately relies on the strength or ability of the Flying Performer. The use of bungee cord or other elastic lifting medium in the direct load path is outside the scope of this standard. This document does not pertain to fall protection. This document does not apply when a performer is supported in a non-overhead suspension manner, such as lifts, elevators, turntables in stages, raked

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				stages, treadmills in stages, or stage wagons. Systems for flying the general public or for people engaged in non-entertainment flying effects are not included in the scope of this standard."
116.	SCI	3	In section 3, I strongly object to the job structure. This structure is specific to large staff theatrical and arena venues. It does not adequately reflect the structure of circus and acrobatic rigging jobs. This standard requires personal that may not be needed on acrobatic and/or circus rigging jobs, and in many cases with substantially increase costs without any benefit.	Reject: Intent of role definition is clearly stated in Section 3.1 Intent in the context of all sizes of productions and does not relate to staffing.
117.	SCI	4	In section 4, the design and construction is specific to wire and track flying systems. The vast majority of this does not apply to acrobatic rigging systems (e.g. bungee setups).	Reject: Content of this section is consistent with the scope defined in Section 1. Bungees are specifically excluded from the scope.
118.	SCI	4.2.4	In section 4.2.4 Strength, this does not allow for design methods used for acrobatic rigging (e.g. bungee)	Reject: Bungees are specifically excluded from the scope.
119.	SCI	4.2.5	In section 4.2.5, this standard states "Manual performer flying systems shall be designed to incorporate all of the requirements of this standard, with the exception of: 4.10 Electromechanical actuation." I object, as many aspects of this standard do not have any reasonable application to circus or acrobatic rigging.	Reject: The manual rigging sections of the standard relate directly to any flying system that falls within the scope of the standard, whether used for circus, acrobatics, or other live performance. Bungees and connections that rely on the strength or ability of the Flying Performer are excluded from the standard.
120.	SCI	4.2.6.3	In section 4.2.6.3, this standard states "Flying System Designer shall promote redundancy in design to mitigate single point failure points and cascading failures." I object to the standard attempting to apply this to acrobatic rigging. Redundancy often introduces complexities that can endanger safety. In most acrobatic and circus rigging, the KISS principal, along with the well established weak link analysis protocols has proven to be a safer method of design than a focus on redundancy.	Reject. Redundancy is an established principle to be promoted in engineering design, and is included in most building and other codes. It relates to structural, mechanical, electrical control, operational, rescue and other systems in performer flying systems. Notwithstanding, there may be specific elements for which a single feature is deemed preferable, based on the risk assessment and risk reduction study

#	Commenter	Clause	Comment	
				performed during design as described in the standard. In order to clarify the intent, change to: "Flying System Designer shall promote redundancy in design to mitigate single point failure and cascading failure. In situations where single points or cascading failure points of support are unavoidable, the Flying System Designer shall use a suitably conservative design factor to mitigate risks based on RA/RR." Add Annex note: "A4.2.6.3: Elements with single point failure conditions are common in performer flying, such as winch lines and carabineers. Suitable safety factors are used to mitigate these single point failure risks."
121.	SCI	4.2.6.5	In section 4.2.6.5, this sets standards for end stops for traveler track. These tracks are rarely used in circus and acrobatic rigging, and this should not be applicable to it. This section should include language to the effect of "where traveler tracks are used..." This should be taken as a general objection, applicable to many other parts of this standard, especially given the language of 4.2.5.	Reject: title of the section states that the end stops are for traveler track. It is clearly understood that this section does not apply where traveler track does not exist.
122.	SCI	4.8	In section 4.8, lifting medium seems to disallow the use of bungee, a primary part of most acrobatic rigging. This is an unacceptable situation for acro and circus rigging.	Reject: The Scope section states "The use of bungee cord or other elastic lifting medium in the direct load path is outside the scope of this standard."
123.	SRI	4.5.1.1	4.5.1.1 - Excluding harness' outside the entertainment industry seems like an unnecessary step. If a harness is appropriately rated, and is more suitable for the task at hand, why not use it? For example. I once rigged a series of high tension lines across the nationals stadium park, using winches to travel performers across it's length at a high rate of speed. For this we used harness' normally used for hang gliding. As they were rated and designed for changing speeds and directions, after an inspection and rick assessment,	Accept in principle. "The flying harness shall be designed or selected by a qualified person solely for the specific purpose of creating flying effects in an entertainment performance environment, unless otherwise determined by a qualified person based on RA/RR."

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			they were deemed appropriate and worked well.	
124.	SRI	4.5.1.2.2	4.5.1.2.2 - As well as indicating the W.L.L of the harness, MBS should also be noted. Its important to know the tear strength of each anchor. For instance, I often use jerk vests when using high speed equipment. Using multiple loops, we can simulate a "crash pack". Meaning initial loops will tear at 1 or 2KN and main suspension loops will hold through 10 or 25kn. Understanding the rating for every anchor and its change through dynamic loads is important. Further, it may be important to site the use of load regulating devices like crash packs or load limiting devices (screamers).	Accept in principle. Modify the label requirements as follows: "4.5.1.2.2.1 Manufacturer and contact information 4.5.1.2.2.2 Working Load Limit ~~4.5.1.2.2.3 Style of harness~~ 4.5.1.2.2.3 Date of Manufacture 4.5.1.2.2.4 Serial Number ~~4.5.1.2.2.6 Expiration date~~ 4.5.1.2.2.5 Applicable Warnings 4.5.1.2.2.6 Reference to User Manual" Add the following: "4.5.1.2.4.1: When lower design factors are used in the design of harnesses, the label shall clearly indicate usage limitations. Such harnesses may only be used if deemed acceptable by a qualified person based on RA/RR." "6.4.1: The installing qualified person shall ensure that the harness is being used within its intended limits of usage." "7.9.5.2: Performer flying harnesses shall only be used as specified on the harness label or harness manual." "A4.5.1.2.2: Warnings and/or user manual specifications should be used to clarify important requirements, e.g., that both

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				sides of a hip harness must be used or built-in shock absorption mechanisms are included. Harnesses designed and constructed for a specific individual and/or for performing a specialized stunt should clearly denote the use.
125.	SRI	4.10.1.2.4	4.10.1.2.4 - The use of W.L.L may not be entirely appropriate here. Where a winch may be rated by factory to lift or hold under power a relatively large amount, this may not result an appropriately specified suspension device. Brake specs should be based on load, maximum speed of travel, maximum aloud stopping distance and the affects on the human load at cat 1 and 0 (in all directions).	Reject. The commenter makes some valid points, all of which are part of proper system design and RA/RR. The industry standard, and the most fundamentally sound test, is to use 125% of WLL for each individual load securing device. Other considerations must be given when using ultra-high speed winches, including extensive brake testing under various stopping conditions.
126.	SRI	4.10.2.16	4.10.2.16 - Requiring all lifting devices carrying human load to have mechanical release should not be required, where safe rescue is possible as a 1st scenario (other than rope rescue) I.E Boom lift, Ladder, Gantry or swing stage.	Reject. While simpler means of rescue may exist in some instances, in many instances release of the brakes to lower the performer is one of the quickest methods of rescue available and therefore, we feel that the ability to do so is a requirement. The document as written does not disallow simpler means of rescue. In situations where it is difficult to access the brakes, other means including remote release of the brakes would be prudent.
127.	SRI	4.13.2.2	4.13.2.2 - I have designed and planned a number of rescues and executed several in the field under real conditions. I have never seen a situation where my primary is guaranteed. Electromagnetic brakes can weld shut, mechanical failures can occur. There should always be a plan B.	Accept in principle. This subject is now covered in Section 4.13.4. Change to: “Secondary and subsequent rescue systems are required. Secondary and any subsequent rescue systems shall be employed when situations arise that do not allow the safe use of the primary rescue system.”
128.	SRI	General	With regard to Automated flight by machine (winch or motor), I see no	Reject: There is no specific reference to

#	Commenter	Clause	Comment	
			reference to the pulling capacity of the individual motor units themselves. When designing 3D rigging, one of the most important steps crosscheck of rig size, and payload with winch horsepower and rope diameter. I usually try to keep rope breaking strength at at least an 8:1 for max pulling strength of two inline units. -Testing documents should include a full speed inline pull, noting the load pulled. -Load cells my be a good requirement for 3D rigging, when potential there is potential to strike objects, when there are possible inappropriate slack line conditions, or when the pulling compacity of the unit is greater than a given safety ratio. A good step is to reference actual position, with commanded position, and not let this error window get outside a window (position error). At high speed, or with a large horsepower unit, you may not have noticed lifting scenery or pulling something (or someone) through a grid before this error window is achieved. Insuring that you cannot pull as hard as your weakest link, is a primary step.	the text of the document. Nevertheless, these recommendations are all valid means of reducing risk, but they are overly prescriptive and not the only means of reducing risk. (1) Line pull test: While this is not a bad idea, making it a requirement is overly prescriptive. Motor selection should be based on anticipated load. (2) Load Cells: These are a good idea in any system particularly for a 3D rig, making it a requirement is overly prescriptive. (3) Position error: This is a good idea; however, not all systems have position feedback or monitoring of programmed position versus actual position. For some flying rigs, there are means to ensure sufficiently safe systems without requiring position error data monitoring.
129.	SRI	General	I have taken a few passes at the document, and I have further notes regarding definitions etc, but I thought I would wait for some feedback before i spend further time in review. Thanks very much for your time and I wish you the best of luck.	Reject. No action required.
130.	DSDT	4.2.6.3	4.2.6.3 ** supply direction for designing parts of the system that cannot be designed out of a single point failure ". . . and cascading failures. Any part of the system that cannot be designed without a single point of failure should have a 12:1 design factor."	Accept in principle. Change to: "Flying System Designer shall promote redundancy in design to mitigate single point failure and cascading failure. <u>In situations where single points or cascading failure points of support are unavoidable, the Flying System Designer shall use a suitably conservative design factor to mitigate risks based on RA/RR</u>."

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				Add Annex note: "A4.2.6.3: Elements with single point failure conditions are common in performer flying, such as winch lines and carabineers. Suitable safety factors are used to mitigate these single point failure risks.
131.	DSDT	4.2.7.1.3	4.2.7.1.3 ** clarify that the mark is from the manufacturer to remove any doubt "Purchased components selected shall be supplied with a visible load rating mark from the manufacturer or certification of its load rating or strength."	Accept in principle. This subject is now covered in Section 4.2.9.1.3. Change to: "Purchased components selected shall be supplied with a visible load rating mark <u>from the manufacturer</u> or certification of its load rating <u>by the manufacturer, unless components meet the specifications of 4.2.9.1.4.</u>"
132.	DSDT	4.2.7.1.6	4.2.7.1.6 ** specify that this excludes hooks with spring latches "Hooks without spring latches and other open end terminations shall not be used in the performer flying system."	Accept in principle. This subject is now covered in Section 4.2.9.1.6. The intent is to disallow open end terminations in general. Change to: "~~Hooks and other~~ Open end terminations shall not be used in the performer flying system." Add Annex section. **"A4.2.9.1.6** Open end terminations include hooks without spring latches. As per Section 4.6 Quick-Connect Hardware, any device that opens on a regular basis shall have a redundant means of actuating that open movement. Use of hooks with spring latches or "gates" (for example on chain motors) should be evaluated as part of the RA/RR process and special attention should be paid to potential for slack conditions that may negate any protection the spring latch provides."
133.	DSDT	4.5.1.2.3	4.5.1.2.3 ** correct the punctuation to be plural instead of singular	Accept grammatical change. Change to:

#	Commenter	Clause	Comment	
			possessive “Harness Manufacturers shall provide the following:”	“Harness Manufacturers shall provide the following;”
134.	DSDT	4.8.3.2	4.8.3.2 ** specify where the de-rating factors are published “De-rating factors for welding, heat treatments, bending, or other processes that affect the strength of the base material, according to the American Welding Society D1.1/D1.1M:2006, Structural Welding Code - Steel, shall be applied prior to determining the final design factor.”	Reject: De-rating factors can be found in various nationally recognized sources such as AWS, ASME, CWA, API, and these depend on material (steel, aluminum, or other).
135.	DSDT	4.10.2.2.7	4.10.2.2.7 ** specify that this should apply to every component that has an adjustable setting “...limited by a setting in the variable speed controller. This setting shall be applied to every control component within the system that governs speed and acceleration.”	Reject. We believe that the commenter wishes to eliminate confusion between drive (controller) settings and software settings/programmed moves. While this is generally prudent, the proposed change is overly prescriptive. The drive (controller) governs the output of the motor and it is the intent of this clause to make sure that limitations are implemented at the drive level where they are “hard coded” and not just at the software / cue level. Edit the following: “A4.10.2.2.7 Each mechanized actuation device should be equipped with an overload sensor which would disable actuator movement when the load exceeds the value determined by the RA/RR. The intent of this clause is to ensure that parameters related to safe operation of a performer flying hoist are stored in the drive parameters (“hard coded”) and not kept only as a “soft coded” parameters in the GUI or “front end.” A mismatch between drive parameters and software parameters can be confusing to operators and as such means should be taken to match drive settings with soft coded parameters and cue settings.
136.	DSDT	5.8.4.2	5.8.4.2 Destructive ** clarify what “AHJ” stands for, and correct the	Accept in principle. Add the following

#	Commenter	Clause	Comment	
			punctuation to be plural instead of singular possessive "...and made available to local Authorities Having Jurisdiction (AHJ) if requested."	definition: "2.2 Authority Having Jurisdiction (AHJ): The organization, office, or individual responsible for approving equipment, an installation, or a procedure." Add Annex note: "A2.2: An AHJ is typically the governmental agency or sub-agency which regulates the work, such as a building department, fire marshal, department of labor, health department, OSHA, etc. In most cases, the AHJ is defined by the municipality in which the performer flying installation is located."
137.	DSDT	5.10.2	5.10.2 ** limit the stress put on components by only requiring an FAT if the system has changed or has not been tested in over one year "Commissioning of a performer flying system containing used components requires a full FAT be performed as per 5.6 Factory Acceptance Testing. This does not apply if the system has not changed in design, has had no components repaired, replaced, or altered in any way, and has received a full FAT within the past year."	Accept in principle. Change to: "5.10.1 Prior to being furnished as part of a performer flying system any used components shall be inspected by a competent person and approved for the intended use by a qualified person." 5.10.2 ~~Commissioning of a performer flying system containing used components requires a full FAT be performed as per 5.6 Factory Acceptance Testing~~. When used components are used as part of a new performer flying system, the system shall be tested using FAT guidelines as per 5.6 Factory Acceptance Testing. 5.10.3 When used components are intended to replace worn or damaged parts of an existing performer flying system, the replacement components shall comply with Section 5.10.1." The new language allows for previously assembled system with previously tested

#	Commenter	Clause	Comment	
				components to be installed without undergoing another full FAT, while clarifying the need to perform a full FAT when used components are utilized in a new system configuration.
138.	DSDT	6.3.1	6.3.1 ** require the language to be English "All equipment used in a performer flying system shall have documentation in English demonstrating proper completion of installation and commissioning. ..."	Reject. Plasa does not specify language for documentation. It is assumed that the language would be the prevailing language of the intended users.
139.	DSDT	7.2	7.2 Operational documentation ** require the language to be English "A performer flying system shall have documentation in English describing the care and use of its equipment..."	Reject. Plasa does not specify language for documentation. It is assumed that the language would be the prevailing language of the intended users.
140.	DSDT	7.5.2	7.5.2 ** specify that all findings during inspection and adjustments made be documented "...whether it is being used for rehearsals or performances. Any observation of note and any adjustments made shall be documented and submitted to the Flying Safety Supervisor. The Flying Safety Supervisor shall..."	Accept. This subject is now covered in Section 7.6.2. Change to: "The performer flying system is to be visually inspected daily, preferably before each use, regardless of whether it is being used for rehearsals or performances. The Flying Safety Supervisor shall designate an inspector, and shall supervise such inspections. Any observation of note and any adjustments made shall be documented and submitted to the Flying Safety Supervisor."
141.	DSDT	7.11	7.11 Post-use ** include "the" before "maintenance manual" to read better, clarify that the information that should be documented is the component type and its condition "...serviced (cleaned or otherwise maintained as per the maintenance manual), documented by type and condition, and stored..."	Accept. This subject is now covered in Section 7.12. Change to: "Upon completion of the system disassembly, all reusable components shall be thoroughly inspected, serviced (cleaned or otherwise maintained as per the maintenance manual), documented by type and condition, and stored in accordance with the System Supplier's recommendations. Non-reusable components shall be discarded and or

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				destroyed as per the System Supplier's recommendations."
142.	TT	General	The asterix sceme throughout the document is not reader friendly. Might it be changed to a footnote system?	Accept in principle. All annex sections will be referenced to sections. Asterisk will be replaced with "(See Annex note.)"
143.	TT	4.5.1.2.2.6	4.5.1.2.2.6: States that the label of a performer flying harness will include an expiration date. In the last decade, fall protection harness manufacturers have moved away from having their harnesses automatically expire after a given time from the manufature date or start of service life; they are good for an inderterminate amount of time as long as they pass an annual inspection by a qualified person. This was due to the using public being upset that they had to replace perfectly good equipment, even if it had never been used, just because a certain amount of time had passed. OSHA/ANSI also have no code on synthetics expiring. They too have policy of the equipment being usable until it fails an inspection, be it pre-use or annually. I suggest this code follow the same policy.	Accept. Expiration date has been removed.
144.	TT	4.6.2	4.6.2: I would change the word "simultanious" to "independent". This language is more in keeping with ANSI codes on locking hooks and carabiners. Also, to open a double locking carabiner those actions cannot be simultanious. Ex: "...shall require at least two independent actions to open/unlock."	Accept in principle. Change to: "All quick-connect hardware shall require at least two actions to open/unlock. <u>These actions can be simultaneous or sequential</u>. The number of required actions shall be determined by RA/RR."
145.	TT	4.13.5.3	4.13.5.3: I fully understand why you would say rescue ropes should meet NFPA 1983, however for the end user this is not ideal. NFPA 1983 states that a life safety rope must be 1/3" in diameter. This will require the end user (rescuer) to carry two seperate descent devices. Using the example of the Petzl I'D, rope work is done on the I'd S which fits diameters up to 12mm. When you go up to 13mm you must move up to the I'D L, This requires people to carry twice as much gear. Also, again using the example of the Petzl I'd, there is no way to open the I'D Lin the air and have it safetied off; the I'D S does provide for this ability. In common Fire Rescue scenarios this is not an issue as the I'D L is pre-rigged in a bag and clipped to the anchor. In our world, the rescuer is the anchor. I would suggest the languge read more to affect the ultimate strength of the rope AFTER termination. For example, KM III, 7/16" (a common size among rope access technicians) with	Reject. NFPA 1983-2012 does not preclude the use of ropes smaller than ½" as long as the correct category of rope is used with compatible hardware. The paragraph with be revised as follows: "Rope used for rescue shall comply with NFPA 1983-2012: Standard on Life Safety Rope and Equipment for Emergency Services. <u>Life safety rope may be General-Use or Light-Use per NFPA 1983 and shall be used with compatible rigging hardware, selected to suit the rescue scenarios that</u>

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			a swen termination breaks at 8600lbs, with a knot it would be undeer 5000lbs.	may be encountered in the flying system and the anticipated loads experienced during a rescue."
146.	TT	General	The word "hoist" is not defined anywhere. Is it refering to chain motors only or, more likely, any machine that is used to lift a performer? I would suggest adding the same definition from your Powered Hoist Systems code (3.6: a machine used to raise or lower a suspended load)	Reject: Hoists are referenced to ANSI E1.6-1-2012 "Entertainment Technology – Powered Hoist Systems," which defines the term "hoist."
147.	TT	6.5.3.4.2	6.5.3.4.2: This test (brakes holding 150% static load) is first listed in the Commissioning Testing section and is not listed in the FAT section. I would move it to FAT section as this is mainly a test of the brakes of your winch, and not the system as a whole.	Reject. The document requires each brake to be independently tested to 125% WLL during FAT and commissioning. Static 150% x WLL test confirms the suitability of the entire system to ensure proper system installation, not specifically the load capability of the combined load securing devices.
148.	CDS-2	General	I was just on a job and thought of this. As a freelancer and working in many venues I make sure the performer(s) I am responsible for know how to get out from where they are. For instance a catwalk in the Superdome or the roof of a studio backlot building. Some buildings do not have signage.	Accept in principle. Change 7.8 **Training** to: "All people directly or indirectly involved in the performer flying effects shall be appropriately informed and trained regarding the dangers, hazards, safety measures, operational requirements and procedures, rescue procedures, and responsibilities of the various participants involved in the use of the performer flying system. Training shall include safe access to and egress from all locations where a flying performer connects to the flying system. Personnel directly involved in the use of the performer flying system…"

Additional approved comments on BSR E1.43 with resolutions

On 2 October 2014 a set of draft E1.43 comment resolutions and a revised draft standard were sent to the working group, with instructions to submit any comments on the resolutions or the draft standard to Bill Gorlin before October 20. The comments are reproduced below and were approved by the working group, along with document number Rig/2014-2025r1.

Clause	Commenter	Comment	Proposed Responses
1 Scope	Jonathan Deull	As I travel around the country working with riggers, production companies and educational institutions, I am constantly facing the question: “How does this draft standard affect what we do?” I’m still struggling with this, since based on my reading of the draft, there is still substantial ambiguity. I believe that there remains a risk of confusion in answer to the question (by a rigger or another decision-maker): “Does the standard apply to me and to this production or installation?” I think this is an undesirable result, which could lead to the failure to adopt the standards in situations and sectors of our industry that really need them and to which they are profoundly relevant. The best way I can think of to unpack this is to do a “thought experiment” contrasting and comparing a couple of different common scenarios, all sharing several fundamental characteristics: 1) a live entertainment event, with 2) human performers, 3) suspended off the ground by mechanical means, 4) with or without the use of automated machinery, using 5) a simple and very common system used throughout the entertainment industry: a straightforward pulley system involving a performer, something to which the performer is attached (let’s call it the apparatus – it could be a harness, a ride-on prop, a rope, a trapeze bar, or something else), attached to a lifting medium, running over a set of pulleys attached to structure which change the direction of the load, incorporating a means of raising and lowering the apparatus, attached ultimately to an anchor point capable of holding the load. The performer may be attached mechanically, or by means of	The scope has been revised, and should now be clear to any person skilled in the art.

		strength and skill. But we specifically exclude from our scope the actual point of connection if it is human strength-or-skill-based connection. In other words, in that situation, we consider the entire system up to but not including the point at which the performer is holding on. The question is: reading the Scope of the draft standard, to which of the following scenarios does it apply? **Scenario 1:** The system moves while performer is on it (it "carries" the performer). **Scenario 2:** The pulley components of the system remains static during the actual performance, but the apparatus is dynamic (imagine swinging). **Scenario 3:** Neither the system nor the apparatus moves while the performer is on it, but the performer does. **Scenario 4:** Nothing moves during the performance. A human statue, or, "The Person in the Moon." **Scenario 5:** (A variation of any of Scenarios 2, 3, or 4). To ensure that nothing moves and/or to best meet load-bearing requirements the system is locked into place by the application of a fixed ("dead-hung") attachment to structure. (In other words, we are essentially eliminating the pulley system and imagining it as entirely dead-hung). My answer, as I think you know, is that the standard should cover all of these scenarios. The only "bright line" I can see is that we are putting human bodies up in the air. While not every specific provision of the standard is directly relevant to every performance situation, the key elements most important to safe practices (risk assessment and management, roles and responsibilities, involvement of qualified personnel, proper selection of appropriate rated/tested hardware and equipment including automation, consideration of dynamic loading scenarios, application of appropriate design factors, emergency and rescue planning, and so forth) apply to all of these	

		situations. Given the continuing trend toward a mix of aerial performance disciplines and techniques within the entertainment industry, I believe that there is not a clear distinction to limit the scope to one particular segment. The rigging system designers, and operators should be referring to the same standards whether they are doing Pippin on Broadway, Pink (or any of countless other musical acts) on tour, Peter Pan in any of its possible variations, or – for that matter – a hair-hang performance in a travelling circus. I know you have struggled with this, and once again I hope that this input can be helpful to you.	
4.8.4.1	Robert Dean	Whereas it could be argued that the only difference between the ZFX approach of starting with a 8:1 design factor and 4.8.4.1 (as currently written) with its 10:1 is that both are just the default design factor before the RA/RR which can determine a different design factor (section 4.1), the reality of what this will mean to the Classic Flying industry is a lot of headache, extra time spent, client misconceptions and a decreased profit. By Classic Flying industry I mean hundreds of amateur and low budget professional productions that happen every year using manual flying gear. The companies that work in this industry are Foy, Hall, D2, and ZFX. ZFX alone worked on over 300 Classic Flying production last year and we figure that is somewhere between 40-60% of the market. By number of productions installed the Classic Flying shows are easily the largest part of the entire flying industry and therefor if the entire flying industry is lumped together under one flying standard and that standard has a single design factor as a starting point to be modified by a RA/RR we feel it should be the design factor that we safely use for manual flying which is 8:1. This is the same design factor that D2 (Delbert Hall) uses. If it stays at 10:1 we will certainly be materially affected. If the standard starts with a 10:1 but per 4.1 can be adjusted to 8:1 it will be perceived that 8:1 is risker, less safe, not a good idea, etc. As we pointed out in our public review notes on 4.8.4.1 we	Accept in principle. A reduction in the WLL design factor will be allowed under certain circumstances. The following changes will be made: 4.6.5 “Quick-connect hardware shall be designed and selected with a minimum design factor of 10X WLL, 6X characteristic load and 3X peak load. In situations where the characteristic loads are confirmed by documented empirical testing data or by engineering calculations prepared by a qualified person, the Flying System Designer is permitted to reduce the WLL design factor to 8X.” 4.7.3 “Load-bearing hardware shall be designed and selected with a minimum design factor of 10X WLL, 6X characteristic load and 3X peak load. In situations where the characteristic loads are confirmed by documented empirical testing data or by engineering calculations prepared by a qualified person, the Flying System Designer is permitted to reduce the WLL design factor to 8X.” 4.8.5 “Flexible lifting medium (e.g., rope, chain, band, webbing) shall be designed with a minimum design factor of 10X WLL, 6X characteristic load and 3X peak load. In situations where the characteristic loads are confirmed by documented empirical testing data or by engineering calculations prepared by a qualified person, the Flying System Designer is permitted to reduce the WLL design factor to 8X.”

		have a large amount of experience using 8:1 and it not unsafe. The Classic Flying clients are not engineers or people used to risk assessments. They are school principals, school district lawyers, drama teachers, community theater managers, children's theater directors, church volunteers, ministers of music, etc. Most of them will "freak out" at seeing in the written RA/RR that we determined that we were going to use a "reduced" design factor, even though it is the same design factor that we safely used when we did their production the previous year. The average Classic Flying production has a professional Flying Director on site for three days during which time they install the gear, train in operation and choreograph. All Classic Flying companies listed above use that same business model, there is no time to spare or budget for extra days so no time for explanations of why we used a decreased design factor or how if 4.1 is read correctly this is allowed by the standard. Again these are conversations with people who have most likely never even heard of a risk assessment . The profit margins are not that high on these types of jobs and currently the Flying Director spends approximately 2 hours per client for pre-installation technical discussions, this time will double, triple, or quadruple as we explain to each production why we lowered the design factor from 10:1. I am not arguing safety versus profits, we have 20 years' worth of evidence that 8:1 is a safe design factor for Classic Flying. I will clearly lose profit in the form of lost time on hundreds of productions annually. Our flying directors will most likely have to spend an entire day answering all the questions about a reduced safety factor (that's just sounds scary), which basically means 33% more labor on each production. Additionally because 4.1 doesn't clearly say that with RA/RR the design factor can be lowered, it only says "variations" which my clients or other entities we need to deal with to add flying to our clients productions will take that to mean 10:1 or higher (11:1) because this is safety standard so surely 10:1 would be the absolute minimum acceptably number. The other entities are	4.8.7 "Rigid lifting medium shall be designed with a minimum design factor of 8.33X WLL, 5X characteristic load and 2.5X peak load. <u>In situations where the characteristic loads are confirmed by documented empirical testing data or by engineering calculations prepared by a qualified person, the Flying System Designer is permitted to reduce the WLL design factor to 6.67X</u>." 4.9.1 "Static load bearing components shall be designed with a minimum design factor of 6.67X WLL, 4X characteristic load and 2X peak load. <u>In situations where the characteristic loads are confirmed by documented empirical testing data or by engineering calculations prepared by a qualified person, the Flying System Designer is permitted to reduce the WLL design factor to 5.33X</u>." A2.12 design factor "Possible design codes include AISC 360-10 "Specifications for Structural Steel Buildings" and ADM1-10 "Aluminum Design Manual - Specifications for Aluminum Structures." The LRFD live load factor is typically 1.6. <u>The design factors for performer flying herein are typically 20% greater than their counterparts in E1.6-1. The design factor for WLL provides a conservative safety margin for uncertainty in determining dynamic forces. In situations where there is substantial confidence in determining the characteristic load, the Flying System Designer is allowed to use a reduced design factor for WLL; this reduction may be beneficial in keeping components from being excessively large in situations where the dynamics are relatively low</u>."

		usually ill-informed people who spend their day figuring out how to cover their ass and/or petty individuals who are going to show these incoming vendors who's in charge. I am sure you know the type and can imagine what a headache they will cause when they see use of a reduced safety factor. These entities are not Authorities Having Jurisdiction but they behave like they are and can cause a lot of wasted time. The approach of using 4.1 to go with a 8:1 design factor (provided RA/RR allows it) will also affect our reputation on safety which is the most important criteria in hiring a flying company. Who would want to hire the company that always uses a lower design factor (8:1) than design factor that's in the standard (10:1)??? Again I want stress that our base 8:1 design factor has no history of being unsafe. Whereas we could just adopt 10:1 design factor this will mean an increased diameter size of wire rope on most Classic Flying productions we work on which will affect their visibility. We are in the business of providing the illusion of flight and increasing by even one size in wire rope diameter can destroy any chance of hiding the wires from view.	
4.10.1.2.2	Robert Dean	4.10.1.2.2 (Electromechanical Actuation) The purpose of the load securing devices shall be to independently secure the load at any position. One device shall be directly coupled to the drum or other termination point of the lifting medium. The second device may be located anywhere in the power transmission system. How would this apply to a hoist like a chain motor? It doesn't have a drum in the classic sense instead a chain cog and the lifting media doesn't get terminated to the drum or cog, instead its captured and forced to move when the cog turns. This should be reworded so it applies to non-drummed electromechanical actuation. Can you clarify that as 4.10.1.2.2 is written would a chain hoist	Accept in principle. The following change will be made: 4.10.2.1.2 "The purpose of the load securing devices shall be to independently secure the load at any position. One device shall be directly coupled to the ~~drum or other~~ termination point of the lifting medium at the drive mechanism, such as a winch drum or chain wheel. The second load securing device may be located anywhere in the power transmission system." Add Annex note: "A4.10.2.1.2 Directly coupled means that there is no intervening belt, chain, clutch, gear or other variable device between the load securing device and lifting medium termination point."

		that has two brakes on the motor and that motor couples to the chain cog via gears meet this clause? It appears that as written the chain motor would be prohibited since that would be indirectly coupled. What is “directly coupled” supposed to mean?	
A (general)	John Ringelman	The one comment that I have regarding the revised standard is that there still seems to be many mandatory statements in the appendix section. It is my understanding that any mandatory statement must reside in the body of the standard and the term “shall” is to be used, but any informational statement belongs in the appendix and the term “should” is to be used.	Accept in principle. Each use of the word "shall" references back to its use in the main body of the standard. In order to clarify, the following edits will be made: A4.3.4.1.3, fourth paragraph: “<u>This section states that</u> the Flying System Designer…” A4.3.4.1.6 “<u>This section states that</u> in addition to the effects of G-forces…”
A4.8.2.2	Barry Brazell	I spotted a typo at A4.8.2.2, 3rd paragraph. The words "should be" are there twice.	Accept. Duplicate words will be omitted.